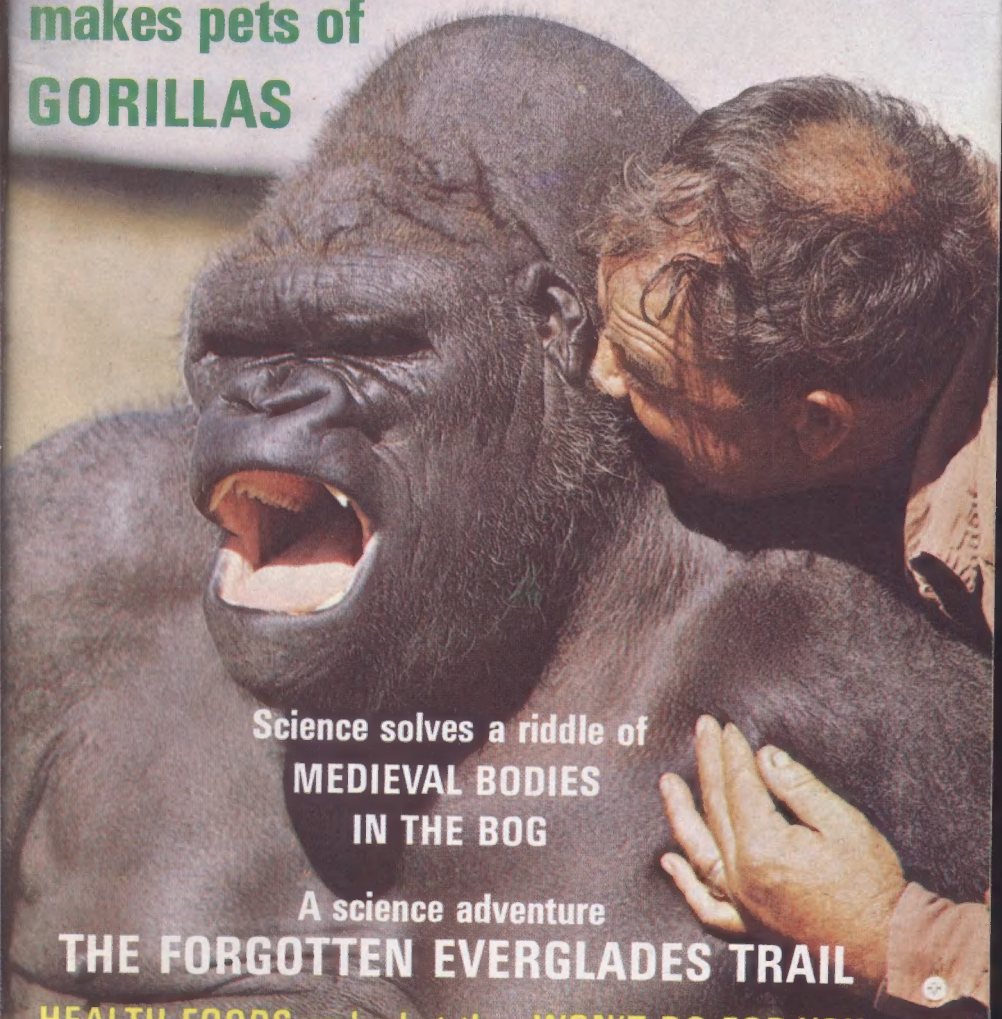
SCIENCE DIGEST

FEBRUARY 1969 • 50 CENTS ICD

The man who makes pets of GORILLAS



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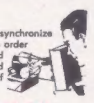

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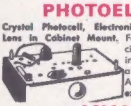
Crystal Photocell, Electronic Amplifier, Relay, large Condensing Lens in Cabinet Mount. Features automatic on-or-off or holding circuit operation. Sensitivity Control, Plug-in Outlet for controlled circuit. Use for alarms, counters, etc. Operates on 115V AC. **A basic unit for many exciting experiments.**



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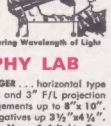

Measuring Wavelength of Light

PHOTOGRAPHY LAB

A PRECISION 35MM ENLARGER . . . horizontal type with twin condensing lenses and 3" F/L projection lens. Produces quality enlargements up to 8"x 10". Contact Print Frame takes negatives up 3½"x4½". **3 Plastic Developing Trays, Neon Safelight, Tray Thermometer, Film Clips, Developing Chemicals, Printing and Enlarging Paper and Darkroom Handbook.** Make quality enlargements for 6¢. Make prints for only 2¢. Full instructions included.

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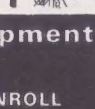
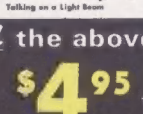
PHOTOMICROGRAPHY CAMERA

Photographs subjects mounted on microscopic slides. Enlarges up to 100X. Takes clear, sharp pictures of specimens too small to be seen with the naked eye. **A fully self-contained unit** — no microscope required. Uses standard roll film, either 120 or 620, black and white or color. **Make a photographic record of your projects with microscopic subjects.**

LIGHT TRANSMITTER-RECEIVER



The TRANSMITTER consists of a **Light Source, a Modulating Reflector Diaphragm** and an Optical Projection System. **The RECEIVER** is a **Two-Stage Audio Amplifier,** controlled by a Photoelectric Cell that catches the projected light beam and causes the original sound waves to be reproduced in the headphone.



Talking on a Light Beam

ATOMIC ENERGY LAB

ATOMIC CLOUD CHAMBER WITH PROJECTOR ILLUMINATOR. the vapor trails of alpha and beta particles, and of cosmic **SPINTHARISCOPE.** Shows exploding atoms. **ELECTROSCOPE** — metal housed with **Scale** and **Magnifying Viewer.** Measures background radiation and tests sample sources. **SAFE RADIOACTIVE MATERIALS.** Alpha Source in handy container and Uranium Ore. **Full instructions and explanations open up the fascinating field of nuclear physics.**

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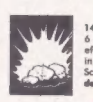
ULTRAVIOLET LAMP



140 watt filter type UV LAMP. Heavy metal cab 6 Foot Cord, Rotary Switch. Produces dazzling effects with invisible black light. Has many in the fields of Mineralogy, Crime Detection Science. Accessories include **invisible Ink, Tracer der, Fluorescent Crayons.**

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A practical Transit. 6X erect image telescope w Range Finder Reticle for measuring remote distan and heights. Vernier reading for both horizontal a vertical scales. Leveling Head with Thumb Sc Adjustment and Spirit Level. Clamps under head t wooden legs of Tripod. (Legs not included.) **Instructi cover elementary surveying, range-finding.**

TELESCOPE AND MOUNT

30X erect image. Extends to 30" length. Five ground and polished Lenses. **Ramsden Eyepiece. Sturdy Equatorial Mount** makes it easy to follow the movement of heavenly bodies. Mount has fittings for wooden legs that complete the tripod (legs are regular 1x2 lumber not included).

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SOME QUESTIONS ANSWERED

Q. How is it possible? It seems incredible to be able to get all equipment shown above in just nine kits — at only $4.95 per k

A. The low overhead of the membership plan is just part of the answ The real key to this amazing program is ABSClub's especi designed multi-use equipment. For example: the Microproje quickly and easily converts into the Spectroscope, Photo Enla and Cloud Chamber Illuminator. Similarly, the Transit Head doul as a Telescope Mount. Such multi-purpose design makes poss this all-science program at a price everyone can afford.

Q. May members choose the order in which they receive their kit

A. Yes. With the first kit members receive a list of the equipment projects contained in each of the remaining eight kits. With information they are able to choose the kit sequence that best s their particular interest.

Q. Can members get their kits all at once instead of one-a-month?

A. Yes. At any time members can have the balance of their kits s in one shipment. We recommend that you start on the kit-a-mo plan because the monthly spacing will give you time to get the measure of knowledge and enjoyment that each kit has to offe

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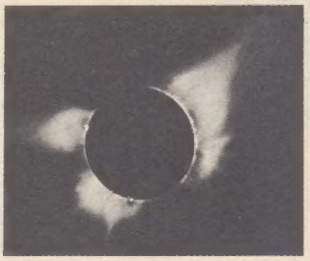

. . . what causes the sun's coronas—both near and far? What curious phenomena they create in Earth's atmosphere? What part the sun plays in the five ways the world may end?

. . . that the world's smallest monkeys—pigmy marmosets—are the size of mice, weigh a few ounces, are talkative, snippy.

. . . how computers are programmed to draw pictures? How sketches like the one here, drawn by an electronic brain in London, was a key tool in solving problems in a study of human factors?

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WSD9B1

THE OLD "SAW" to the effect that "A prophet is without honor in his own country" is really a truism when it comes to the scientific fraternity which, by definition, must approach everything with an air of doubt-until-proven.

But it's great to hear of someone, now and then, who's able to tell the doubters "Aha! I told you so." Such a story came to hand this month, and we pass it along for the poetic justice in it.

THIS MONTH

Ten years ago, it seems, a 16-year-old British schoolboy in Leicester found a 10-inch fossil in an ancient Precambrian rock outcrop on a golf course. He knew enough geology to realize this might be unusual, so sought out a Leicester University geologist, Dr. Trevor Ford. "I made a rude noise at him," Dr. Ford recalled recently, "because no fossil, except microscopic forms, had ever been found in such rock."

Coaxed by the boy's father (a minister), the professor was induced to take a look at young Roger Mason's find. And, it was a fact.

Today, *Charnia Masoni*, the boy's fossil find, has just been included in a new geology textbook of the East Midlands, according to our informants. Scientists still aren't sure if was some sort of jellyfish or a seaweed type of plant. But one thing is sure: it's probably the oldest form of complicated life ever found. Roger was right!—*RFD*

SCIENCE

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SCIENCE DIGEST is published monthly by The Hearst Corporation, 959 Eighth Avenue, New York, N.Y., 10019. RICHARD E. BERLIN, *President;* GEORGE HEARST, *V-Pres.;* RICHARD E. DEEMS, *President of Magazines;* JOHN R. MILLER, *Executive V-Pres., Magazines;* WILLIAM S. CAMPBELL, *V-Pres., Magazines;* ALBERT A. RACHOI, *V-Pres. and Director of Circulation;* RAYMOND J. PETERSEN, *Senior V-Pres. of Magazines;* FRANK MASSI, *Executive V-Pres. and Treas.;* HARVEY L. LIPTON, *Sec.*

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Cover: Norman Zeisloft

FEBRUARY • 1969 Vol. 65 No. 2

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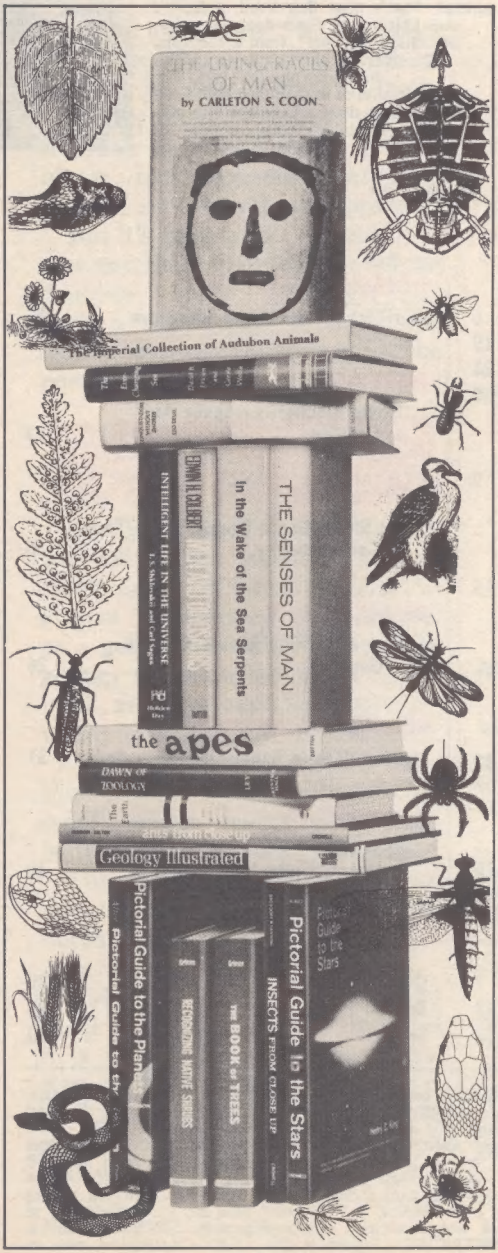
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NEWS IN BRIEF

Bulletins at press time

SAFE RETURN OF LUNAR YO-YO, APOLLO 8, puts NASA's moon exploration timetable into high gear. At press time (a few hours after splashdown and retrieval of astronauts Borman, Lovell and Anders), plans stood as follows: In late March or early April, a three-man crew captained by James McDivitt, will go into earth orbit with Apollo 9 carrying the LEM (Lunar Escape Module). The LEM shroud will be removed; two crewmen will board it, launch it into orbit and re-dock with the mother ship after testing a number of maneuvers. In May, Apollo 10, also with LEM attached, will go into earth orbit for more extensive breakaway and docking maneuvers. There is now talk that Apollo 10 may go into lunar orbit and that the LEM will be taken through landing procedures to an altitude of some 50,000 feet above the lunar surface; then it would return and dock with the orbiting Apollo capsule for re-entry to earth. In June or July, Apollo 12 and its three-man moon exploration team, led by either Neil Armstrong or Charles "Pete" Conrad, Jr., will blast off for the actual landing on the moon's surface, leaving the LEM for short walks across the landing area, collecting soil samples, rocks and making specific scientific observations of what they see.

HOME RUN FOR THE ORBITING ASTRONOMICAL OBSERVATORY was scored when scientists signalled the telescope-studded satellite to train its eyes on three unnamed stars and take pictures. Photographing the stars in ultraviolet (largely shielded from earth's surface by atmosphere), the satellite obtained, and sent to earth, a set of pictures that delighted astronomers. The three stars, barely visible from earth, are 450 to 2,000 light years away in Draco, between the dippers. The satellite, called Stargazer, has 11 high-powered telescopes. Four are expected to produce 50,000 pictures this year -- of things astronomers have never been able to see.

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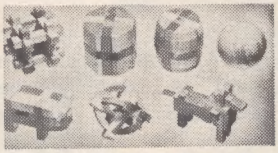

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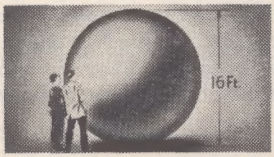

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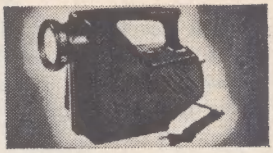

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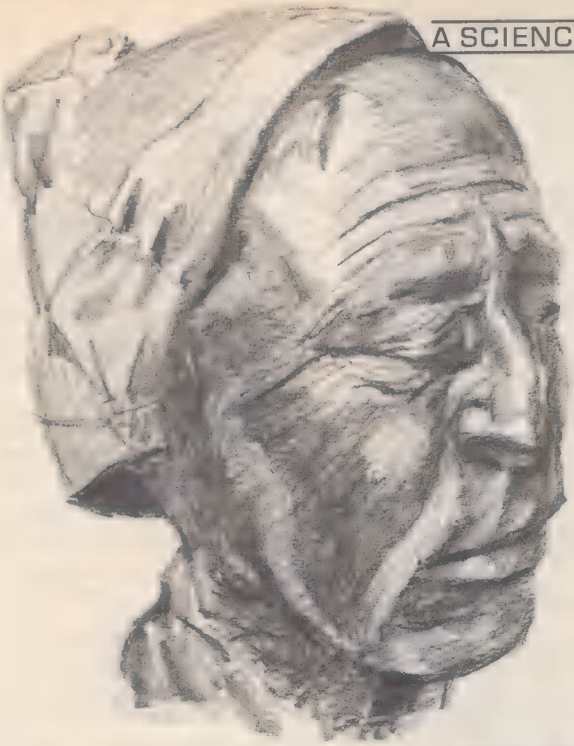
"you bounce cold batch of it like basketball;" "it break the teeth." One tough, grinning peasant summed up the positive: "I have seven children, seven big people to feed. So we think new rice very good exercise."

SEX AND THE SENIOR CITIZEN. Older people could lead active sex lives even at the age of 70 or 80 if it were not for "taboos and inhibitions" of the younger members of society, according to Dr. Alexander P. Runciman of the Reproductive Biology Research Foundation, St. Louis. The decrease in sexual activity in later life has been found to be related to psychological factors more than physical ones. "The idea that life, love and romance belong only to the young is a myth," says Runciman.

FREUDIAN PSYCHOLOGY IN THE DENTIST'S CHAIR may be the answer to some of the problems of periodontal disease (perio means around and dontal means teeth). Dr. Martin R. Protell, a dentist and lecturer at the New Jersey College of Dentistry, believes that emotional disorders may cause a physical chain reaction that ultimately leads to dental problems. Anxiety can actually lower the body's resistance to disease. At Hillside Psychiatric Hospital in Queens, Dr. Protell has noted that at least 50 percent of the patients reporting periodontal disease had personality profiles suggesting continued psychological disturbance.

DEAF MAKE LONG DISTANCE TELEPHONE CALLS, using AT&T's Picturephone, a device that transmits both sound and a TV picture. A group of 20 deaf persons recently used sign language, finger spelling, speech and lip reading to communicate with each other. The picturephone, when it becomes available nation-wide, may be the answer to distance communication problems for the deaf.

A NEEDLE-SHAPED CITY HIGH IN THE SKY may be possible in the next 30 years, according to Hungarian-born architect Wilem Frischmann of London. It would be a two-mile-high building, housing 300,000. Frischmann believes that modern technology will soon make possible buildings with 800 to 900 levels yet be only 1,000 feet wide. He feels that this may be the answer to overcrowded countries like India, and the problems of urban United States.



Drawing by Jack Mitchell

The Medieval riddle of bodies in the bog

Perfectly preserved bodies that are at least 2,000 years old have been turning up in Danish peat bogs. How did the bodies get there?

by Daniel Cohen

FOR NEARLY 20 YEARS now archaeologists have been puzzling over a 2,000-year-old murder mystery. Now after pulling together all the clues, they may have come up with the motive for the crime.

In May 1950, a group of Danish farmers who had been cutting peat to heat their homes came to the police at the town of Silkeborg with a strange story. They said that while they had been digging in a bog at Tollund a few miles outside of the town, they had uncovered a

human corpse. The police knew that many things, including bodies, had been dug out of the Danish bogs before, and they had almost always turned out to be prehistoric. Wisely, they put in a call for professional assistance. They phoned Professor Peter Glob, a noted Danish archaeologist who happened to be lecturing to students at Aarhus University 25 miles away.

Professor Glob was intrigued and started out at once. It was a remote place, "a narrow peat bog among high steep hills in a wild region of central Jutland," (a traditional name for the mainland of Denmark), Professor Glob said.

"In the peat cut, nearly seven feet down, lay a human figure in a crouched position, still half buried. A foot and shoulder protruded, perfectly preserved but dark brown in color like the surrounding peat, which had dyed the skin. Carefully we removed more peat, and a bowed head came into view.

"As dusk fell, we saw in the fading light a man take shape before us. He was curled up, with legs drawn under him and arms bent, resting on his side as if asleep. His eyes were peacefully shut; his brows were furrowed and his mouth showed a slightly irritated quirk as if he were not overpleased by this unexpected disturbance of his rest."

Pictorial Parade

Tollund man was discovered by Danish peat-cutters. His well-preserved body showed the cause of his death—hanging. He was naked except for a cap and belt. Experts' guess? An executed criminal.

The cause of the man's death was obvious. The leather rope with which he had been hanged was still around his neck. Aside from the rope he wore little else; a leather cap on his head and a leather belt around his waist were all the possessions this man had taken to the grave with him.

This was a case of murder, or at least an execution. But if the killers had made any attempt to get rid of the body they had been extraordinarily unlucky, because they had chosen a peat bog, which constitutes one of the most effective mediums available for preserving organic materials. Peat is carbonized and decaying vegetation. It is the earliest stage of the transition from vegetable matter to coal. It forms in swampy bogs in many parts of the world and is often used as fuel in places where coal is scarce. The lower layers of peat bogs contain enough humic acid and tannic acid to kill off decay producing bacteria and start a natural tanning process.

Men and animals are always falling into the bogs and drowning, and you might think that the Danish peat bogs would be loaded with well-tanned bodies of various ages. But the natural preservation does not work quite that easily. The surface layers of the peat contain sufficient oxygen to support a thriving population of bacteria. To be preserved a body must be placed in a hole dug beneath the oxygen-rich layers, and then the hole must be filled in. So this fellow—Tollund man as he came to be called—was not only murdered, but he was buried.

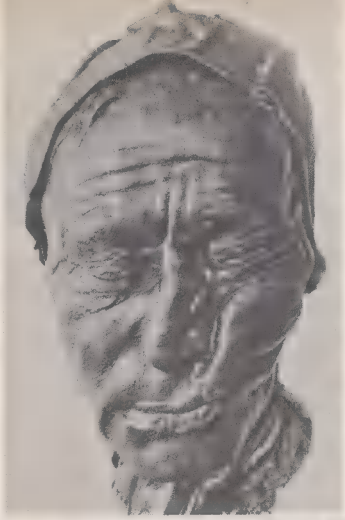
Two years after Tollund man was found, Professor Glob was again called upon to supervise the exhumation of another well-tanned body from the bogs of Jutland. The burial spot was just a few miles away from Tollund, a little bog near the village of Grauballe. There workmen had been cutting peat one Sunday when, six feet below the surface, they came upon the head of a man.

This time the professor decided not to exhume the body in the field. He cut out the entire block of peat in which it was embedded, slid a sheet of metal under it and transported the body and the surrounding peat back to the museum.

Geoffrey Bibby, a young archaeologist at the museum, described what he saw when he came to work that Monday morning: "I arrived... to find a dead body on the floor of my office. On an iron sheet stood a large block of peat, and at one end of it the head and right arm of a man protruded, while one leg and foot stuck out from the other end. His skin was dark brown, almost chocolate colored, and his hair was brownish red." As with Tollund man, this body had taken on the color of the peat.

Slowly the peat was cut away until the body was exposed. "The cause of death could now be seen," says Bibby. "The man's throat had been cut from ear to ear."

An authority on forensic medicine was summoned to perform an autopsy. In a lengthy report the medi-



Pictorial Parade

Head of Tollund man close up shows how well the 2,000-year-old body has been preserved deep in the Danish peat bog.

cal examiner concluded: ". . .the subject is an adult male and the condition of the teeth suggests that he was of somewhat advanced age. . . . On the front of the throat was found a large wound stretching from ear to ear. . . . This wound may with certainty be interpreted as an incised lesion, probably caused by several cuts inflicted by a second person. The direction of the wound and the general appearance make it unlikely that it could be self-inflicted or accidentally inflicted after death. . . ."

At the time of the discovery there was some local excitement about a certain drunken farmhand who had disappeared without a trace 60 years before. But the scientists were confident that Grauballe man was much older than that. When the body was subjected to radio-carbon analysis, the scientists got the death date they were expecting—A.D. 300.

Peat cutters have been digging up the well preserved remains of their ancestors from the bogs of Denmark, Germany and Holland at least as far back as medieval times. Once out of the preserving bog, the bodies would quickly dry out and begin to decompose, and smell, so they were hastily reburied. The bodies were usually so well preserved that people did not know how old they were and believed they were recent remains of someone who had drowned in the bogs, or had been murdered and buried there. Ironically, the bodies of these ancient pagans were often given good Christian reburials.

In 1845 the body of a woman whose hands and feet had been pinned to the ground with forked sticks was dug out of a Danish bog and became quite famous. The body was tentatively identified as that of Queen Gungild of Norway who reportedly had been drowned by the Danish King Harold Bluetooth around A.D. 950. But the woman had been dead several hundred years longer than that.

With the growth of scientific archaeology, scientists have been able to get at least a general idea of when these bodies were placed in the bogs. Radio-carbon dating has since confirmed the early guesswork. All the dates center in the era of A.D. 100 to 300. Julius Caesar may have been alive when Tollund man was hanged. At that time the people of the northern European areas lived in what archaeologists label the Iron Age.

In the last quarter century three preserved bodies have been found in the extensive bogs of Borremose in northern Denmark. The first was a naked man with an elaborate rope noose around his neck. The second was that of a woman, also naked but decently covered with a blanket. She had a leather cord around her neck, but apparently had been killed by a blow on the head. Another woman's body at Borremose was the most grisly find of all—she had been scalped and her face had been bashed in.

About the time of the discovery of Tollund man the body of a young girl was dug up by peat cutters in a bog in Schleswig-Holstein in northern Germany. The exact cause of her death could not be determined, but like the others it must have been violent. She was naked save for a leather collar and the remnants of a blindfold that had been tied around her eyes at the time of her death. The left side of her head had been shaved.

It is obvious that we are confronted with a case of mass murder that took place in northern Europe during the second and third centuries of the Christian era. All the bodies have enough similarities to conclude that their deaths must have in some way been related. All died violently. Most were buried naked, and none of them had the elaborate grave furnishings typical of burials of that era. Ordinary burials did not take place in bogs, and the bog burials themselves were extremely careless. The victims seem to have been dumped into holes in the peat and hastily covered over. Bodies were found lying on their sides, on their stomachs and on their backs. Even the holes into which the bodies had been thrown were probably not specially dug as graves. Scientists have been able to determine that at least in some cases peat had been cut out of the holes, and they were left standing open for years before they were appropriated as graves.

Preservation wonder

The bodies themselves are marvels of natural preservation. Grauballe man has been preserved so long by what amounts to a natural tanning process, and all scientists have had to do is complete that process. The body was stored in an oak vat with a tanning solution for 18 months and examined every month by representatives of the Tanners Guild. "Grauballe man, on exhibition at the Prehistoric Museum in Aahrus, needs only a little linseed oil now and then to last indefinitely," comments Bibby.

But the people who have come by the thousand to stare with horrified fascination into the glass case which contains the body of Tollund man, are not primarily drawn by the wonders of nature or science. They want to know why this man, and the others like him were killed. A number of explanations have been advanced.

All of these people in the bogs may have been travelers who fell

victim to a gang of murderous outlaws who roamed the desolate bog country for several hundred years. The hasty burials seem to indicate this. But the number of bodies and their similarity tend to rule out casual violence.

On the other hand, the dead persons may have been condemned criminals, executed by the brutal justice of an Iron Age society. Tollund man and the others had eaten nothing but grain in the days before their death. Was this the traditional bread and water diet of prisoners? We do know that hanging was a common method of execution among the tribes of that time. It was the punishment for treason which may be why only male bodies show signs of strangulation.

Sacrificial victims

Still the most widely accepted explanation is that all of these people had been sacrificial victims. In A.D. 98 the Roman historian Tacitus wrote an account of the Germanic tribes of his time. One of these tribes, the Angles, inhabited Jutland. Tacitus noted that the tribesmen worshiped Nerthus, a sort of mother earth goddess. Every year a great and secret ceremony was performed around the image of the goddess in order to assure the fertility of the crops for the coming year. Writes Tacitus: "This service is performed by slaves who are immediately afterwards drowned in the lake. Thus mystery begets terror and a pious reluctance to ask what that sight can be which is allowed only to dying eyes."

Much of what Tacitus reported was heresay. Water filled bogs may have become lakes in the retelling, and several other methods of execution may have been used in addition to drowning.

The English scholar, Sir James G. Frazer, compiled a massive work of 12 volumes called the *Golden Bough*. His basic aim was to prove that primitive peoples sacrificed human victims as part of a magical attempt to insure the fertility of their crops. He compiled enough evidence to indicate that this was a common, indeed almost universal practice. Faint traces of ancient sacrificial rituals could still be found in many of the ceremonies which accompanied the planting and harvesting of grain among the peasants of Europe, even into this century.

One last bit of evidence strengthens the case that the bodies in the bog were sacrificial victims of an agricultural fertility ritual. The food found in the stomachs of the bodies was a mixture of grain and seeds. There was not a trace of fruits, vegetables or meat. Grains and seeds will keep over the long winter; fruits and vegetables will not, and after a winter meat is scarce. Therefore it seems almost certain that Tollund man and the others were killed by their companions in late winter or early spring. This is the time when most tribes performed sacrifices in the hope that the victim would be reborn in the growing crops.

All photos Bureau of Sport Fisheries and Wildlife

CONSERVATION

How goes the battle of the whooping crane?

This three-day-old whooping crane chick is a rare commodity today, but strong public interest in the whooper offers hope that it can be saved from extinction.

by Michael J. Walker

MANY PEOPLE have lived out their lives in New York City without ever seeing a truly wild animal. And yet, at a party in the midst of this "wildlife desert," I was asked by all 10 present about the whooping crane. None had ever seen a whooper, but they were all visibly concerned with its future, asking questions such as: "How many are left this year? Why is it faced with extinction? Can we save this bird? What are we doing to help?"

I asked them why they were so interested, and got a query in return: "How can we as people survive if a harmless beautiful bird can't?"

Others expressed the fear that another member of the living world may expire, joining a growing list and raising the prospect that much of our precious wildlife heritage will be lost, leaving only rats and starlings.

Then I devoted much of my two-hour stay at the gathering to supplying statistics about population, habits of the bird and actions of people that have led to its threatened existence, and some of the measures being taken to help. But the question that disturbed everyone the most went unanswered: "Can we save the whooper?" I couldn't make a prediction, given the sad situation the bird is faced with.

First, the population of this bird is so small—there are less than 50 left in the wild today—it may be beyond the rescue point.

Second, the whooper takes off

Whooping cranes fly nearly 3,000 miles from their winter home on the coast of South Texas every spring to northern Canada, to return to Texas with a few young in the fall.

each spring and fall on hazardous 2,600-mile migrations during which time much if not all of the flock could be wiped out by careless hunters, sudden hail or snow storms, high-tension lines and low-flying planes.

Third, it is a poor breeder, the parents hatching two eggs a year but usually rearing only one chick. It also takes several years for the birds to mature before they can breed.

Fourth, many resting and feeding sites have been so disrupted by people and progress that it is doubtful a sizeable population could thrive.

But at least in the case of the whooper—as contrasted with many others like the passenger pigeon that expired in the past—widespread public concern has been aroused and measures are being taken.

We are, for example, in the critical stage—dubbed by the Interior Department as "Operation Whooping Crane"—of an exciting Federal Government program to save the bird from extinction. Former Interior Secretary Stewart L. Udall in 1967 hailed the initial part of this operation as a "major achievement in our efforts to preserve a species from extinction."

Involved in Operation Whooping Crane is the taking of extra eggs from the nests in Canada, artificially hatching the eggs at the Bureau of Sport Fisheries and Wildlife's Patuxent Research Center in Laurel, Md., and rearing a flock of whoopers there in capitivity. The hope is that eventually a flock of breeders can be reared to bring forth young for release into the wild to bolster the whooper population.

In this joint U.S.-Canadian venture, scientists at Patuxent for several years studied the closely related sandhill crane to learn breeding and feeding habits. During the late spring of 1967 and 1968, Canadian biologists took one egg from several nests, knowing that if care were exercised the mother birds would not abandon the remaining eggs.

In 1967, six eggs were taken and four chicks survived. In 1968, seven chicks survived out of 10 eggs taken. Both groups are growing nicely, bolstering hopes that a

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breeding flock will develop to maturity. The biologists also know from work with captive whoopers in the United States that the mature birds in captivity will hatch eggs and rear young.

Thus, adding the other captive birds retrieved from the wild with injuries and nursed back to health, there are now 19 whoopers in captivity. Adding this to the 1967 wild population of 46, we now have possibly 65 or more whoopers alive.

The fact that we have *any* is amazing since it was not until 1938 —when the population had shrunk to less than 25—that a safe wintering home was set aside for them in the United States. In that year, the Department of the Interior established Aransas Refuge on the Texas Gulf Coast as a permanent winter haven for waterfowl and whoopers.

Grus americana—the scientific name for the whooper—is one of the largest of North America's native birds. It stands five feet tall and has a crimson crown and black-tipped wings that spread about seven feet in flight. Except for these colorings, the bird is a beautiful pure white and has a ringing bugle-like call. Each whooper may live as long as 40 years.

There probably never was a large population, but up to a century ago they ranged over much of the continent from the Arctic to central Mexico and from the Rockies to the Atlantic. Their habitat, however, shrank as Americans tamed the land. Many were shot, even after they came under the international protection of the Migratory Bird Convention by Canada and the United States in 1916. By the 1930s, remarkably few were left, vainly struggling for existence.

Each spring the remaining whoopers make a hazardous flight of 2,600 miles from the Aransas National Wildlife Refuge to the region of Great Slave Lake in northern Canada. In the fall they return with a few young. They generally fly high on the migrations, sometimes even out of sight, but at other times within a careless shooter's range.

In flying north from Aransas, the cranes move across Texas, Oklahoma, Kansas, Nebraska, North and South Dakota and Saskatchewan. Their nesting area is confined to Wood Buffalo Park, a tremendous wilderness in northern Alberta and the adjacent Northwest Territories. One of their stop-overs in this great flight is in central Nebraska along the Platte River where the birds feed and rest. This area, however, is not protected, so we don't know how long the birds can continue to

Whoopers have beautiful black-tipped wings that span seven feet in flight.

enjoy this stop-over.

In Canada, breeding pairs lay one or two buff and brown, mottled eggs in moundlike nests on the ground. The eggs are laid two to four days apart, and the female begins incubation after the first is laid. It takes about 34 days for the fist-sized eggs to hatch, and the new chicks are about half the size of an adult robin. Growing rapidly, the young are ready for their first flights in about 90 days, and after several practice flights are ready to accompany their parents on their long journey to the wintering grounds.

Family establishment

Appearing in family groups over several weeks' time, the whoopers usually arrive at Aransas in mid-October. Each family establishes a territory of a few hundred acres which is guarded against intrusion by other whoopers, but left open for use by waterfowl and shore and wading birds which share the same wintering ground.

Here at Aransas, the birds receive more attention than at any other place, as aerial counts are made once a week and frequent boat patrols assure their well-being. Visitors are not permitted to enter the birds' habitat, but they can observe a few from a concealed observation tower near the territory of one family group.

In late winter, restlessness signals the start of spring migration to the nesting grounds, and in late March and early April the family groups begin departing. Family groups stay together until the nesting grounds are reached, at which time the young leave their parents.

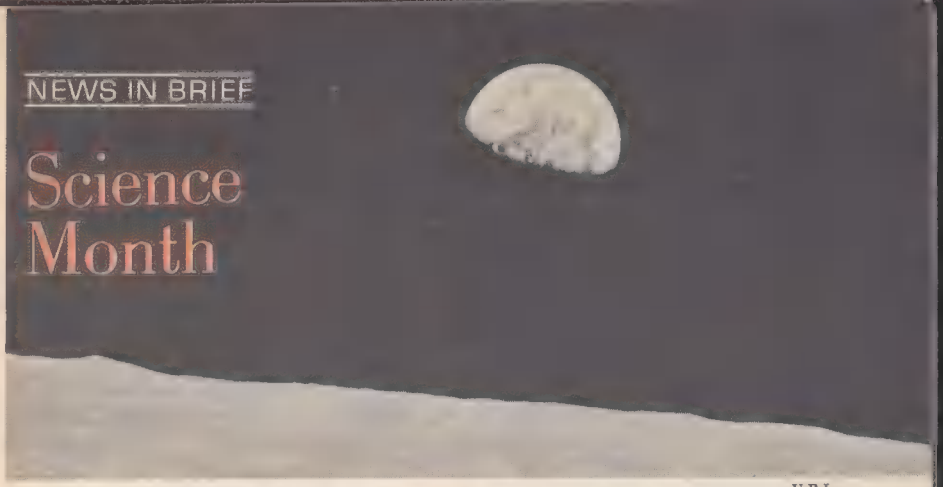
At the nesting habitat the birds are by no means secure. A severe windstorm or unseasonal blizzard or hailstorm could wipe them out of their nests. It is for this reason that many wildlifers believe the survival of the species rests on breeding captive birds to rear young for bolstering the wild flock each year.

One of the leading private contributors to the welfare of the birds has been the National Audubon Society, which was instrumental in getting oil companies to curtail planned operations that could have imperiled much of the cranes' winter habitat. The society also employs a warden to patrol 7,000 acres of Matagorda Island, Texas, which some of the birds use. Continued protection of this island is essential for the birds' welfare.

But other groups, besides the U.S. and Canadian Governments, including the National Wildlife Federation, have done much for the bird by educating the public to its plight. We still have an occasional careless hunter, as we did in the fall of 1967 in Texas when a whooper was shot near Aransas, but most now are careful not to shoot large birds on the wing for fear they might be whoopers.

The success of these and other efforts, however, remains to be seen, as we still don't know whether we can save this magnificent bird from extinction.

Science Month



U.P.I.

Lunar landscape, caught in "earthrise" glow by Apollo 8, harbors new health hazards.

Lunar Medicine

by Harry Goldstein

Will future moon travelers' medical kits contain exotic anti-radiation compounds to protect them from solar flares? Or interferon-stimulating drugs to protect them from strange micro-organisms? Or potent psychotherapeutic drugs to counteract the unnatural silence and solitude?

Oddly, Apollo 8's medical kit for the historic moon-circling flight could have been found in almost any home medicine chest: Common pain killers like aspirin and Demerol; motion sickness remedies; antibiotics; nasal decongestants; diarrhea tablets; Dexedrine stimulant pills; Seconal capsules; eye drops; skin irritation cream and Band-Aids!

To learn what the first moon explorers might carry along for "first aid," *AMERICAN DRUGGIST* put these questions to NASA:

Q. *Since the moon has little or no atmosphere to absorb radiation, will medication include some type of anti-radiation drug?*

A. Data already obtained indicates there is no reason to expect hazards from increased radiation. We are not planning to include anti-radiation drugs.

Q. *Since the first moon explorers will be isolated for extended periods, will there be psychotherapeutic agents in their medicine kit?*

A. The astronauts are in continuous communication with the ground. They are far less isolated than many research groups on earth. There are no plans to carry psychotherapeutic agents.

Q. *Would bleeding (as a result of an accident) be more profuse for a man on the moon, due to lack of atmospheric pressure?*

A. An astronaut could not sur-

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vive on the lunar surface without a pressure suit which affords him life support systems as well as protection from heat, cold and micrometeorites. If injured he will bleed in his pressure suit as he would on the earth.

Q. *Is consideration being given to the possibility that the first moon travellers may encounter unknown viruses or bacteria?*

A. Yes. In the NASA Lunar Receiving Laboratory astronauts and samples they bring back will be quarantined for periods of up to 30 days. (*Science Digest,* October, 1968).

Q. *Will problems of gravity affect heart and respiration?*

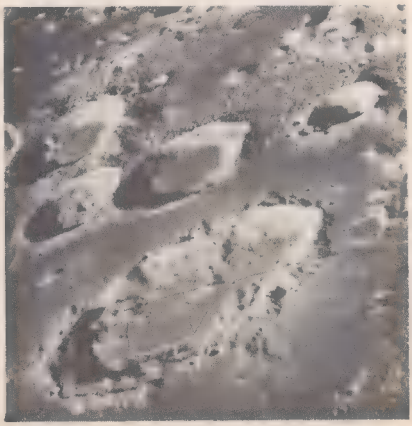
A. Studies on the physiological state of man in low-G state have been conducted for six years. Data indicate that the human system can take these changes. No drugs are considered to combat these problems.

Q. *How would drugs be administered to astronauts on the moon?*

A. Medication would be administered inside the Lunar Module or the Command Module, orally or through injection. There is a special seal on the leg of the pressure suit for injections.

Answers above refer to the short space flights anticipated for the next few years. Flights of a month or more might incur unknown health risks. One possibility: long flights might cause harmless bacteria and viruses to mutate—and become virulent. Future spacemen may need compounds that will stimulate the body to produce virus-fighting interferon.

Soviet space dogs lost calcium from their bones during prolonged flight and developed edema. Future space medical kits may have to be stocked with calcium pills. Then, too, drugs may have different effects in space than on earth. If true, this could produce a whole new set of problems in space medicine.



On lunar surface, left, astro explorers may be subject to strange maladies. Medication will be given in LEM or capsule.

Real brain food

Some food substances apparently go directly from the mouth to the brain, says Dr. Morley Kare of the *University of Pennsylvania*. He fed sugar with radioactive Carbon 14 to rats and was surprised to find that the radioactivity reached the brain in less than a minute. The direct mouth-to-brain pathway could explain the rapid regulation of salt needs that takes place in the human body, says Dr. Kare.

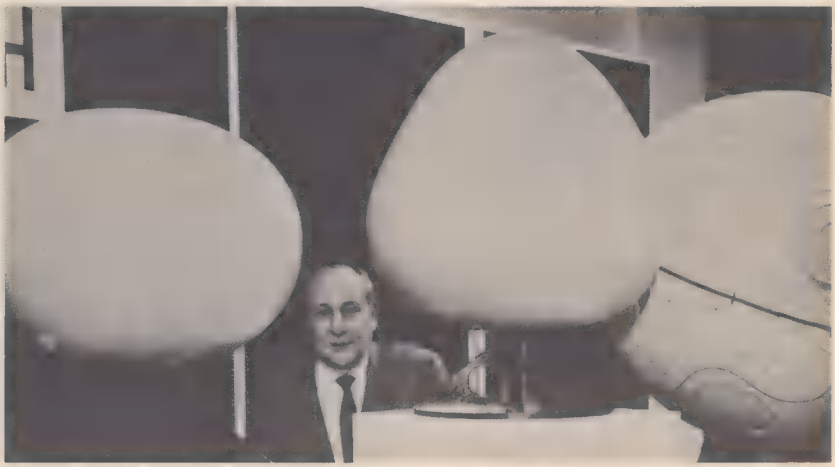
A fish story

It will never replace fillet of sole on a restaurant menu, but fish protein supplement may soon become an important source of protein in some diets. A Cardinal Proteins plant in Canada will manufacture it in the form of a tasteless white powder that can be added to basic foods in protein-deficient areas. As little as 10 grams costing less than a cent are said to supply one person's daily requirements. The supplement utilizes varieties of the fish catch that are not readily saleable.

Sea monster of a turtle

The fearsome sea monsters sighted over the centuries may be nothing more than big turtles, says *The Sciences*, a publication of the New York Academy of Sciences. The theory is advanced by L. D. Brongersma, a Dutch zoologist, who points out that the 10-foot-long Leather Back Turtle is a native of

Man-made blood vessels (above) are made of polyester velour fabric; will aid vascular disease patients. Developed by Goodyear. Hamster (below) is having teeth treated with fluoride to retard tooth decay, part of federal program studying dental hygiene.



U.P.I.

Shape of the earth as determined by satellite signals shows three basic configurations: left to right, triaxial ellipsoid showing earth flat at poles, pear-shaped globe, and a terraced globe which is the most precise image indicated thus far.

locales where sea serpents are most often sighted. The turtle fits almost all the criteria of the monsters: it has a blunt head carried well above the water on a medium length neck, a smooth brown back and a white underside. Of course it's much shorter than sea serpents are supposed to be, but Brongersma thinks this characteristic might be unseen or exaggerated in sea serpents.

Ancient necklets found

When Malcolm Tricker, a 26-year-old British excavator operator, turned up five yellowish metal objects with his bulldozer not long ago, he took them home to his wife. She picked one up and put it around her neck. It fitted nicely. Tricker took the objects off to the Ipswich Museum, which declared they were first century gold necklets of an unusually fine type. The necklets are in the form of braids with an open circle on each end. Each weighs about two pounds. Precious metal objects from the first century are extremely rare in Britain.

Poor feel poorly

Poor people tend to think their forebears had better health than they do, according to a Harris poll commissioned by Blue Cross. The most pessimistic group interviewed were Appalachian whites, 63 percent of whom thought their health was worse than their ancestors. Fifty-one percent of Negro families living in the slums thought the same about themselves. Surprisingly,

Spanish-speaking poor are less inclined to think themselves unhealthy, possibly because they have chosen to come to the United States to improve their lot, say pollsters.

Look out for meteors

About 40,000 tons of meteors enter the earth's atmosphere each day, but chances of your house being struck by a sizeable one are slim—much less, according to a Lockheed Missiles and Space Company scientist, than the chance of it being hit by an airplane.

The heat of atmospheric entry breaks down most large meteors into such small pieces that they are either mistaken for pebbles or float around in the atmosphere like dust, says Albert D. Anderson. "A man is lucky if he sees one meteorite the size of a pebble in his lifetime," he reports.

Only one case of a meteor striking a person is on record—a woman in Sylacauga, Alabama, who was slightly injured on November 30, 1954, when an eight and one-half pound meteorite crashed through the roof of her house. A few animals, however, have been reported killed by meteorites—the term for meteors when they hit the earth's surface.

With this record, Anderson and Lockheed aren't particularly concerned about meteors striking the earth, but they do worry about large-size meteors crashing into a planet like Mars, which may be visited by astronauts on a space mission. Mars has so little atmosphere that it may well be hit by large-size meteors now and then.

"It may even be necessary to have astronauts tunnel under the surface of Mars if they need to stay there for an extended period," says Anderson.

The few big meteors that have reached the earth's surface make the prospect of a meteor bombardment on Mars an alarming one. The biggest meteor ever found on earth is the Hoba meteor in southwest Africa, which is estimated to weigh 60 tons. Another huge meteor that struck Africa made a crater with a floor 30 miles across. The Barringer crater in Arizona is six-tenths of a mile across.

These big meteors, Anderson estimates, can strike the earth at speeds in excess of 20,000 miles per hour. Smaller ones travel more slowly, but even one less than an inch in diameter may land at a speed of 60 miles an hour.

Poisonous butterflies

The Monarch butterfly, one of the most beautiful insects in the world, carries enough poison to kill a cat, researchers report in *Science*. Both pupae and adults contain a toxin which resembles digitalis and is distributed throughout the insect's body. Although many predators avoid the Monarch, some animals eat it without any apparent ill effects. Monarchs acquire the poison by eating plants of the Asclepiadaceae family.

NEW FOR PEOPLE

Two for the price of one—parking time and electric car rejuvenation may one day be available. Rockwell Manufacturing, Pittsburgh.

First pressure chamber X ray at Children's Hospital Medical Center, Boston, (below) may save new-born blue babies. By Picker Corp.

Housewife of 1975 may use a solid state keyboard (above) to do shopping, banking and make appointments. Keyboard is linked to computer through circuit encoding board on left which translates symbols to electronic language. Micro Switch, division of Honeywell Inc., 11 West Spring Street, Freeport, Illinois.

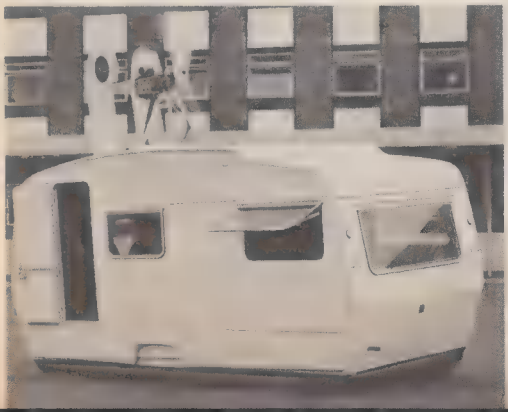
"Prequest" slide test for pregnancy (left) only takes couple of minutes for highly accurate results. Here is first of three steps to test. One drop of urine is added to drop of anti-HCG serum, followed by drop of latex-HCG substance. By Parke-Davis & Company, Detroit, Michigan.

Cleaning fine jewelry and other household items will become a fast, easy chore with this new Branson Ultrasonic Cleaner (below) that uses high-intensity ultrasonic energy to clean items in water-filled tank. By Branson Instruments, Stamford, Conn.

Boy or spaceman? Actually, Calvin Grindel of Chicago is wearing a colorfully decorated, helmet-like plaster cast so he can take Betatron treatments to correct a hypothalamus abnormality affecting his rate of growth. Openings assist treatment.

U.P.I.

Pictorial Parade



Hoversprite (left) is an air-cushion vehicle that operates on two 600 cc. horizontally opposed twin-cycling engines. A modified 14-foot Sprite Musketeer, it is capable of moving at 35 m.p.h., accommodating four sleeping berths, kitchen, dinette, wardrobe and toilet. Built by Hoverquipment Co., Lydd, Kent, England, for research to determine the potential for air-cushion propulsion.

All photos by Norman Zeisloft

Tommy, a 600-pound male gorilla, is a pet for Robert Noell who runs Noell's Ark Chimpanzee Farm in Tarpon Springs, Fla. At 10 years old, the ape has two more years before maturity. Gorillas in captivity generally weigh more than they do in the wild—due mainly to an abundant diet and inactivity.

The man who makes pets of gorillas

The animal that has always been regarded with fear or disgust turns out to be a docile, obedient pet. He is even "fragile" and must be scrupulously cared for in order to survive diseases.

By Dick Bothwell and David Coleman

THIS GIANT weighs as much as three good-sized football players, puts dents in cars with irreverent nonchalance and scares the daylights out of practically everybody. Yet, looking like an enormous, hairy Buddha, this gorilla, Tommy, has a side to him that many people would not suspect—he's a gentle, even loveable pet.

Robert E. Noell, who runs Noell's Ark Chimpanzee Farm near Tarpon Springs, Fla., has been raising gorillas for almost 20 years. He knows from experience that these anthropoids (meaning man-like) are neither as ferocious nor as hardy as they look.

"We got our first one in 1950," says Noell. "She only lived a year. Then we bought a male; he lived a year. The third one lived four or five years. . . ."

Noell's Ark lost two more after only a few years (each pet costs about $5,000). But they have managed to keep Tommy for the past 10 years.

Because of their high price and tendency to catch colds and more serious ailments easily, there aren't many "pet" gorillas in the U.S. Tommy is one of the few privately-owned ones, and it's been estimated that there are only about 85 in captivity in the whole country.

People just aren't used to seeing 600-pound King Kongs walking around, and the frenzy of activity that follows one of Tommy's unannounced appearances rivals the slapstick comedy of the Keystone Cops.

The day he waddled calmly into the midst of a group of railroad workers near Tarpon Springs is still cause for a string of frenetic adjectives from stammering workers who couldn't believe their eyes and who involuntarily joined in the fad of seeing how many people could simultaneously cram into the nearest parked car.

Noell's Ark often tours the country, and one of the attractions of his troupe is his wrestling matches with the giant ape. The animal's huge, black hands palm the man's head as a pitcher would palm a softball. Part of the routine includes Tommy putting Noell's

Wrestling with his owner is one of Tommy's favorite games. He has been trained since infancy to play "gently" and will even share a banana mouth-to-mouth (below) though it looks like more than just fruit is about to be devoured. The wrestling match is part of Robert Noell's act with the gorilla when they tour with Noell's Ark Chimpanzee Farm. Noell loses his shirt every time they perform—literally.

arm between his jaws in mock bites.

"When we're on the road," he says, "I go into the cage with Tommy each night. And I always tell the audience, 'This may be the last time.' But he's gentle; we brought him up like a child."

But this "child" can be extremely dangerous all the same. The largest of the anthropoid apes, gorillas weigh around 450 pounds at maturity and reach a standing height of about 5½ feet. Tommy weighs considerably more than a wild gorilla due to lack of exercise and a diet of two bushels of fruit and vegetables every day—and he won't be fully grown for two more years.

Gorillas have moods of irritation and anger just as humans do. They are the most dangerous during these periods because they lack the restraint and discipline of humans—behaving much the same as a criminally insane person.

However, Noell has raised Tommy from an infant. The animal has been conditioned over the years and

Tommy beats on his chest as is characteristic of his species, but it is done with cupped palms rather than fists. Contrary to the popular belief, gorillas seldom use their fists for this ritual. Noell often takes his pet for walks at the end of a small chain, but it's more like the other way around most of the time. Noell generally looks like a small boy trying to "walk" a great dane. The chain is only a symbol of Noell's control.

cringes when his owner speaks sharply and raises a hand in threat.

The ape is so well-trained that Noell can even share a banana with him (page 28) mouth-to-mouth—it's all part of the act.

Theatrical as it seems, Noell has accomplished a remarkable job of training the beast. Gorillas—unlike chimpanzees and orangutans—do not learn easily. Although gorillas have shown an ability to solve problems involving the use of tools such as sticks and stacked boxes to reach suspended food, they are ". . . slow in adaptation and limited in initiative, originality and insight" according to studies conducted by the American psychologist R. M. Yerkes.

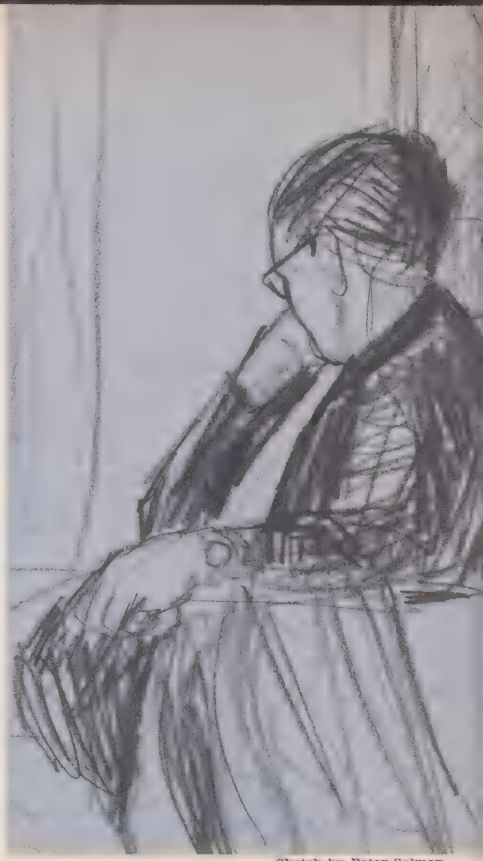
The owner's method of reward, praise and punishment has resulted in a *relatively* well-behaved pet. The reward part of the training is a little rough on Noell's wardrobe, however. He keeps candy in his shirt pocket, and the ape knows it. The removal of candy along with the whole pocket is a daily occurrence. Noell's shirts come from Goodwill Stores by the dozen, at 15¢ each.

Known technically as *Gorilla beringei*, gorillas such as Tommy come from the high mountains of the eastern Belgian Congo. A similar species (*Gorilla gorilla*) thrives in the forest regions of West Africa. It's main difference is a much thinner coat of fur than the eastern form.

These anthropoids are docile vegetarians. They won't attack unless severely provoked or threatened; but when their anger *is* aroused, they become extremely dangerous aggressors. Tommy, if angry or afraid, has been known to dash about attacking anything in sight. One of his casual swats has been known to put a $50 dent in Noell's parked car.

But Noell is not discouraged by Tommy's behavior. In fact, he has another "pet" like Tommy growing up right now—Tarpie, a three-year-old, 60-pound female.

MEDICINE



Sketch by Peter Salman

AGING

the disease with a cure

by Bruce Frisch

PEOPLE still have the idea that if a specific disease isn't God's will, *aging* is," snaps Dr. F. Marott Sinex, professor of biochemistry at Boston University. "As a result, private foundations don't call on us to wage war on aging as we do on cancer, heart disease, stroke or muscular dystrophy."

No matter how many individual diseases we conquered, says Dr. Alex Comfort, pioneer aging researcher at University College, London, we would simply add only ten years to our lives on the average. More people would reach the normal maximum lifespan, about 75, but the maximum would not be extended.

To really extend maximum lifespan we must learn to control the fundamental processes of aging. Such understanding may open up to us anything from a more vigorous life to potential immortality. A rough average of all predictions might point to a lifespan of 100 by the year 2000. This 25-year gain would be nearly as great as all the years so painfully added to our lifespans during the last 400 years. But they are ours only if we go after them—and we have not. In desperation at seeing such an opportunity

go unexploited, researchers in aging are trying to get Congress to establish a superagency empowered to spend ten times more than the Federal Government presently allots to learning the causes of aging.

Ten years ago we started getting a big step closer to the specific causes of aging when Dr. Nathan Shock began pinning down for the first time what happens to our bodies as we age. In his longitudinal study, Shock follows a man through his lifetime, comparing the old man with his young self.

Every 18 months, or every 12 months for those 70 or over, each of the 600 volunteers spends two and a half days at the Baltimore Gerontology Research Center, a unit of the National Institute of Child Health and Human Development, taking part in a complete cycle of 70 physical, chemical, psychological and sociological tests.

He squeezes a grip-strength gauge sits in an "electric chair" lifting, pushing and pulling, and walks a treadmill. Inside an electrically-shielded room, he signals the highest tone he can hear. He breathes through a pair of convoluted tubes to check his lung capacity, and tests his working power by hand-cranking an electrical generator.

After the first decade of gathering data, Shock concludes, "Aging begins when growth stops," around 18-20. Almost all functions then start declining slowly. At 30, they begin deteriorating at a faster but still modest rate which remains constant until death. In plain language, we go over the hill at 20, and the downgrade steepens after 30.

We lose weight; reaction times slow; we cannot take as big breaths; our strength ebbs; we cannot work as hard. Even the ability to enjoy the world diminishes as hearing fails and taste buds stop functioning.

Why? Shock believes it is because of the gradual death of cells —our reserve capacity or strength that enables us to recover from disease or injury.

A glut of theories seeks to explain why cells die. The Association for the Advancement of Aging Research has a committee for each of 19 different theories. In recent years, a swing has begun to "loss-of-information" theories.

Every cell in the body has stored in its nucleus a full set of blueprints for the entire body. All this information stretches down a long, lad-

Changes in nervous system due to aging are monitored by measuring sensory and motor nerve conduction velocity at the Gerontology Research Center, Baltimore.

Eyeball pressure test (above) is one of many checks on age changes in human performance at Gerontology Research Center in Baltimore. The same test can also detect eye disease known as glaucoma.

Photo by Bruce Frisch

"Electric Chair" (left) is equipped to measure grip-strength, ability to push, pull. Subject's general strength and degree of deterioration is electrically measured every 12 to 18 months in program.

der-like molecule of a compound called deoxyribonucleic acid (DNA) —sort of like a series of codewords. Various intricate mechanisms read out the instructions, carry them from the nucleus, gather raw materials and assemble those according to the directions.

The final product may be an energy-producer, a repair material, or as in the glands, a hormone sent off for use somewhere else in the body. Loss-of-information theories hold that some flaw develops with age in the information store or in its translation.

The most direct evidence was uncovered by Dr. Leonard Hayflick at the Wistar Institute in Philadelphia. As each cell divided, it made a copy of its DNA to hand on to its progeny. After about 55 generations, cells taken from embryos died out. Those from older persons petered out in as few as ten. "I suggest that animal aging may result from deterioration of the genetic program that orchestrates the development of cells," Hayflick concluded. "As time goes on, the DNA of dividing cells may become clouded with an accumulation of copying errors."

Recently, Dr. John Gofman from the University of California Radiation Laboratory suggested the in-

formation is misplaced when one particular short segment of DNA goes astray. Only gross errors of this sort can be seen by scientists. DNA is most easily seen when it divides into 46 paired lengths called chromosomes, during cell division. At this time, some chromosomes appear too long, too short or broken.

The collective failings of the cells appear as symptoms of the degenerative diseases and the ravages of age, according to Dr. Howard J. Curtis of Brookhaven National Laboratory in Upton, L.I. He finds more malformed chromosomes in the cells of older mice and fewer in those of long-lived strains.

This somatic mutation theory—*soma* meaning body, and *mutation* meaning the errors in the DNA—has probably been the most widely-held hypothesis, but has slipped in recent years.

Many known chemicals and radiation can cause mutations, but none has been proved to cause aging. Radiation comes uncannily close, however. X rays or radio-activity seems to chop years off an animal's life. It suddenly looks older, gets the normal killing diseases earlier and dies sooner. Many scientists think the imitation of aging good, but still an imitation.

The striking similarity nevertheless prompted Dr. Denham Harman of the University of Nebraska to feed mice a drug for radiation sickness. The drug, 2-MEA (2-mercaptoethylamine hydrochloride), made them live longer.

Later, Harman fed mice compounds which have a similar chemical action and which are normally added to human food or animal feed to prevent spoiling. The most successful, BHT, which breakfast cereal manufacturers put in their packaging materials "to preserve freshness," extended the lives of mice tested by an average of 50 per cent.

Harman concludes that radiation and other agents set loose chemically-active atoms or groups of atoms called free radicals. These react with many materials in the body, including DNA. Copper in the blood can promote the harmful reactions; the drugs he has tried inhibit them.

Dr. Sinex concentrates his attention on the nerve cells, which die off at the rate of 10,000 per day and are never replaced. Those remaining, with the muscle cells, are as old as the body. Since the nervous system, along with chemical messengers, keeps the body's parts working as a team, its deterioration "is more likely to be at the root of physiological performance," he says. "Coordination is the thing that really fails." A body that could not coordinate its defenses against disease would soon die.

Scientists have actually known how to double the lifespans of animals by diet for over 30 years. In the early 1930s, Dr. Clive McKay of Cornell University fed lab rats a balanced, adequate diet, but one just above starvation level. After three years, when they would ordinarily have been dead, they still

looked young. He then restored them to a normal diet, and some lived up to three years longer.

An accidental McKay experiment may have taken place in Sweden during World War II. The Swedes had little to eat, but saw that everyone got his share. The mortality rate dropped. When the war ended the U.S. "helped" the Swedes by shipping them food. The mortality rate rose.

Almost all the work on these theories is being done by about a dozen men and their associates, Shock estimates. Their progress has been entirely too slow to suit Dr. Bernard Strehler, director of the biology laboratory at the University of California's Rossmoor-Cortese Institute for the Study of Aging. Early last year he formed about half the aging researchers and a number of other interested persons into the Association for the Advancement of Aging Research and bulled ahead with a plan.

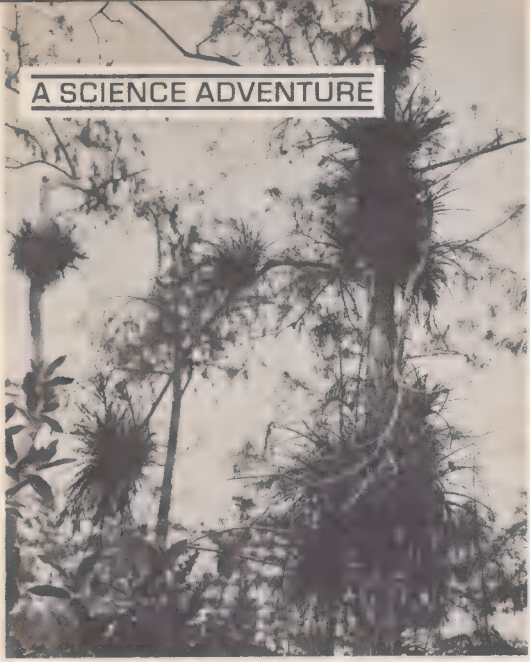
Last June, the AAAR drew up a legislative proposal which was incorporated into a "Preliminary Gerontological Research Act," introduced to the U.S. Senate in July. The bill would establish a temporary Aging Research Commission to draw up a five-year program of research by next July. The association hopes Congress will then extend the life of the commission and give it $30-50 million per year to carry out the plan.

Shock says: "Our problem is not money. Our problem is brains." In reply, AAAR scientists point out Shock gets more money than any other researcher on aging and has just moved into a brand-new $7.5-million building. Of the roughly $5 million earmarked for aging research each year, "darn little" goes into research really directly related to aging, claims Harman. "They're trying to shore up old persons." And even Shock admits that in this year of belt-tightening, "A hell of a lot of grants are going down the drain."

If researchers on aging could, in fact, help us live to 100 by the year 2000, as some of them predict; if you would like to live 30 extra years; and if extra effort would help insure it, then their debate is more important than an internal squabble. But to get up to a quarter-billion dollars they will need public support. So the basic problem remains our ambivalence toward seeking longer life. This curious attitude infects even the scientists. On this, Shock speaks for most: "The goal of the Gerontology Research Center is ultimately to improve the lot and capabilities of aging people. We do not strive to make people live longer."

But Comfort scorns "the falling over backward to avoid admitting that if we now devote time and money to studying aging, it is because we wish and intend to get a control over our lifespan of precisely the sort that the alchemists desired. To some scientists such an admission seems a little disreputable; yet if they work on aging, that is why they do it."

A SCIENCE ADVENTURE



Bushy-headed cabbage palms grow on the tree islands scattered along the road through the Everglades swamp.

Easy way to explore the Everglades

An almost forgotten road that winds through Florida's Everglades allows the adventurer to explore the swamp safely.

by George X. Sand

DURING LAST SUMMER'S Republican National Convention at Miami Beach, several delegates asked if they could explore Florida's great Everglades swamp, where the only true tropic flora and fauna in the U.S. are found.

"Forget it," they were told.

The tour brochure experts explained that it would take days to inspect the brooding 3,500-square-mile miasma, where the water is too shallow to allow passage by boats, yet too deep and boggy for land vehicles. Mounting an Everglades expedition, they pontificated, calls for guides, airboats, half-track machines—and a lot of money. Novices are often snake-bitten and lost in dangerous areas; some die there.

True. But there *is* a way to probe the fascinating depths of the Ever-

glades safely and inexpensively. And you can be your own guide. Few people other than local old-timers know about the half-forgotten trail that threads the heart of the great swamp, and not all who do will tell you about it.

To do it calls for a total investment of half ■ tank of gas and half a day of vacation time. The excursion will take you on a slow drive along a trail labeled "Fla. Hwy. 94," a long-ignored secondary dirt route known as the "Loop Road."

Road through the swamps

In 1916 the State of Florida began to build the now famous Tamiami Trail through the heart of the Everglades. The original route was intended to connect Miami and Tampa along a direct route from the Atlantic Coast to the Gulf of Mexico. At Forty Mile Bend, some 32 miles west of the Miami city limits, an already completed portion of the highway was abruptly abandoned, due to political maneuvers, so the trail could veer off in a northwestward direction. This detour left a 24-mile section—Loop Road—that today proceeds westward through the heart of the swamp, rejoining the Tamiami Trail again at Monroe Station. It is ■ deteriorating, gravel surface route, bumpy and overgrown in spots but amply wide and safe at reduced speed.

Note your speedometer reading as you leave U.S. 41 to enter Fla. 94 at Forty Mile Bend. Approximate mileage points are important for locating certain interesting things to be seen en route. Except for the tiny swamp hamlet of Pinecrest and a few scattered dwellings, the road itself will be your only proof that you are not the first white invader.

Within the first mile you'll see several species of strange birds, particularly during the early morning feeding period, and when the seasonally shifting fresh water level is high elsewhere in the Everglades. A small flock of long-legged, long-billed white egrets may suddenly swoosh in for a landing right beside you on the open sawgrass prairie.

Perhaps a large wood ibis will land unexpectedly in the top of a slender custard apple tree growing on the far bank of the canal that borders one side of the road. The branches of this tree are too slender to support the three-foot-tall member of the stork family. He tries to land anyway. Annoyed, the ibis flaps mightily to maintain his balance, finally manages to fold his wings and come to a precarious rest. The baldheaded bird, known to Florida naturalists as "old ironhead," resembles a Beau Brummel in formal attire, due to its white and black feather patterns.

You can expect to encounter water birds, too, in season: blue and Louisiana herons, chuckling and splashing ducks, coots and the beautiful purple gallinule with bright red and yellow beak and blue frontal shield. One water bird, the anhinga, or snake bird, swims with only its serpentine head and neck above the surface. The anhinga

U.S. Dept. of Interior

Sawgrass is the only vegetation that will grow on the prairies between the scattered tree islands, or hammocks. Air boats prove to be good transportation in the Everglades.

lacks sufficient oil to waterproof its feathers adequately, and often can be seen perched in a tree with wings outspread—looking as though it had been hung on a clothesline to dry.

The odd, scattered tree islands, or "hammocks," appear on both sides of the Loop Road. These foliage clumps are splattered across the bosom of the sawgrass sea in a random pattern. Bushy-headed cabbage palms and other tropic and semi-tropic trees grow in profusion on these islands. But, for some reason, nothing except grass grows on the prairie in between.

The sawgrass you see growing here is the short, relatively harmless Everglades variety. Elsewhere in the swamp a hazardous variety, *Cladium jamaicensis*, grows as tall as 12 feet. Its serrated edges slash clothing and flesh like a sea of broad swords, should a man force his way through the thick growth.

At *Mile 3* the setting changes abruptly in a forest of dwarf cypress trees. Elsewhere in the Everglades, cypress trees grow more than 100 feet tall, yet the oldest trees here stand barely as high as a man's head.

Gradually, shrubs and trees thicken, enfolding the trail and hiding the plain. Wild holly with bright red berries burgeon in season, along with many other growths like pigeonwood, wild tamarind and gumbo-limbo. Custard and pond apples hang from trees and shrubs. The Miccosukee Indians, natives of the Everglades, eat this wild fruit.

Near *Mile 7* on the right, lies the first large hammock within easy walking distance of the road. To explore it, you will want to pull on leather boots (wear knee-high rubber boots if it's the summer wet season). They'll protect against snakes and odd-shaped outcroppings of limestone that can trip you. These curious rock configurations date back 50,000 years, when this site was a shallow, warm sea bottom.

On the big hammock, light filters through a canopy of moonflowers and other tangled growth. Underfoot, the forest floor is thick with leaf mold. The still air is spiced with the strange chocolate fragrance of a lavender orchid, *Epidendrum pambense*. Twenty-two kinds of wild orchids are native to the Everglades, but few are as beautiful as

the Epidendrum. One, the massive *Cyrtopodium punctatum*, grows on trees (it resembles clusters of cigars) and gets so large two men can't lift it.

The number of tropic trees and shrubs increases as you probe deeper. Vegetation with names like mastic, Joewood, wild cinnamon and dilly abound. More than a thousand flowering native and foreign plants grow here. Most of the imports arrived in seed form from Cuba and other West Indian countries, carried in by the Gulf Stream or blown across on hurricane winds.

About 50 ferns and related forms grow in this area, including the only tree fern in this country (*Dryopteris ampla*). One native plant, the *Agave neglecta*, requires only half a dozen years to grow a dozen feet or more in diameter at its base, and shoots even faster—sometimes two feet per day—in height. One, according to naturalist Charles Torrey Simpson, grew 42 feet high in about one month!

If you look closely in this hammock you may find tracks of whitetail deer in the low places, and those of the big bronze Florida wild turkey, tawny panther and black bear. Some of the largest black bear in the U.S. roam here.

Your next stop should be at about *Mile 9*, where a large drainage culvert passes beneath the road. On the right there's an overgrown woods road, now only a faintly discernible trail in places where it parallels a stream bank. Follow this path on foot, back into a cypress swamp that may be flooded at times. Here's a whole world of grotesque cypress "knees"—leafless root growths which thrust above water level and are believed thus to permit the trees to obtain oxygen.

Wild limes grow here, too. If you walk far enough, you may find the "soapberry" which, when crushed and allowed to soak in water, produces a lather than can be used for washing. There is also inkwood, ironwood and torchwood. This last contains so much resin it can serve, when burned, as a bright flaming source of light.

Perhaps your most interesting encounter here will be with the *Ficus aurea* or strangler fig—a grim killer tree. The seed of the strangler would stand little chance for survival if it fell to the dark forest floor. But its fruity exterior is attractive to birds

Strangler fig demonstrates why it is known as the killer tree of the Florida swamps.

who carry the seed aloft to places where it can survive.

When the bird alights on a limb and drops the Ficus seed, it begins to germinate immediately. Before long it becomes a healthy plant (not a parasite) with leaves that spread along the tree limb from a single stem. Next, threadlike roots drop to the forest floor below, where they quickly attach themselves and dig in. Some of these tiny roots are wrapped around the trunk of the host tree by winds, and grow together, building up a ruthless network.

In time the supporting tree is enmeshed in a haphazard lattice of strangling roots. These smooth tendrils now begin to grow, first to human finger size, then to arm and leg thickness, slowly filling in all gaps as they expand. The host tree, gradually robbed of light, air and moisture, begins to die. Eventually the original trunk crumbles and the steadily growing killer tree then fills in that last center area.

At *Mile 11,* stop off at the little log cabin on the left. Its grizzled owner, 82-year-old Macdonald Johnson, may be at work in his garden. He helped build the Tamiami Trail in the mid-20s, and can tell colorful tales about the days when plume bird, alligator poachers, rum-runners and other outlaws sought refuge in this portion of the great swamp.

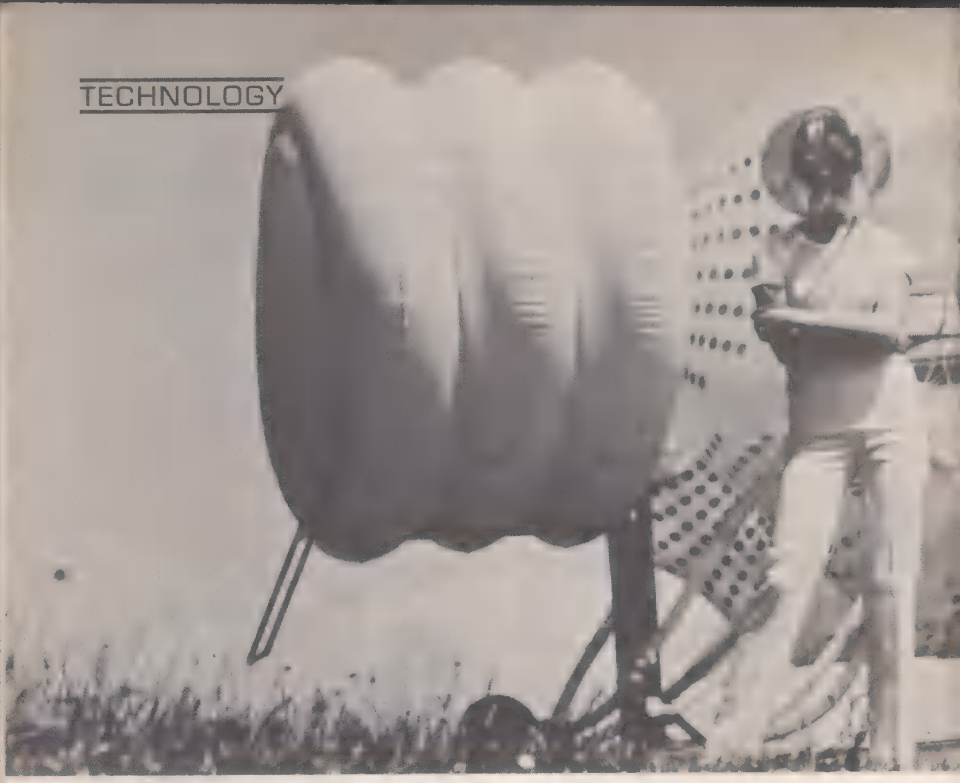
The road becomes almost overgrown at about *Mile 14.* You'll drive through a large cypress "head" or bog. There's a profusion of air plants in the crowded trees, garfish and largemouth black bass swim in the water pools formed where culverts pass beneath the road. The small pike-like garfish is a throwback to prehistoric times. Long-snouted and ugly, it has interlocking scales so hard that flint can be struck against them. The Indians who live in the Everglades consider the gar a delicacy and bake the fish whole in their campfires, without bothering to remove the entrails.

End of the journey

At *Mile 17* you come to another area of dwarf cypress. The trees look gray and dead, but they're not. Wild blueberry bushes along the road grow 12 feet high and are loaded with tasty fruit in season.

You'll roll into Monroe Station at *Mile 24,* and your journey has ended. Talk to white-bearded Dixie Webb, proprietor of the quaint way station, and enjoy his booming hospitality. With his shoulder-length hair, Webb resembles a Biblical prophet. He'll sell you a sandwich of barbecued Everglades wild pig and relate how he first passed this way in 1928. He may invite you to inspect the restaurant's many sides of bacon, homemade sausage and smoked hams hanging from the ceiling.

As you drive back to your hotel or motel, you'll come away with a distinct feeling that you have lived in a Lost World; a world still unspoiled by the depredations of mankind; one that goes back to the beginnings of time. And, as a matter of fact, you have.



SCIENCE DIGEST SPECIAL

The crazy things they'll use

by Arthur S. Freese

HOW ABOUT a flying saucer for a home—or a plastic house which can be assembled by school children in a week using their after-school hours? There are even houses built with spray guns that shoot plastic foam—all available now.

The construction industry is entering a period of unprecedented growth—there are forecasts of over 2,000,000 new housing units per year by 1970. To cope with this, Mr. William F. Rooney, a spokesman for the Georgia-Pacific Corporation of Portland, Ore., pointed out to me that the building materials industry is moving forward on two fronts—first to new products and second to new applications of the old ones. These changes have increased rapidly over the last several years. Rooney pointed out that the cost of land and on-site construction is hastening technological research because we can no longer afford to drive 67,000 nails, one at a time, into the average residential house. Panel construction, compo-

As populations and prices soar, science and industry are searching for new materials for construction—and they let their imaginations run wild doing it. The contraption at the left is an example of the innovations. It's called a "Yellow Heart" because the inflated yellow plastic pulsates.

to build your new house

nents and large surfaces—all applied with simplified fastening methods—will be the only way we can hope to afford tomorrow's housing.

Simplified fastening methods are exemplified by the newly introduced high-performance adhesive, B. F. Goodrich Plastikon-400. According to H. L. Dixon, general manager of Goodrich's Adhesives Division, this material has both water and heat resistance (up to 200°F.) and can bond wood, wood products, fiber glass, concrete, brick, aluminum, steel, leather, rubber, cork, paper and fabrics. Typical exterior uses are bonding sheet siding, sheathing, batten strips, roof panel and gable end components.

This Plastikon illustrates the possibilities inherent in modern adhesives—it retains its adhesion, resilience and strong impact resistance over long-term aging and compensates for the varying rates of expansion of different materials. It even has "bridgeability" and can span gaps up to ⅜ of an inch, thus eliminating the necessity of costly precise alignment work and shim-

ming, and making possible the bonding of irregular surfaces. Adhesives make it possible for the home handyman to do many more jobs, for they are so strong that they can bond a four-foot by eight-foot panel to ordinary studs with over 67 tons of holding power. No more eyesores due to face nailing—nail holes, hammer dents and putty marks; no more squeaky floors or outside nail staining.

An excellent example of Rooney's application of technological research to construction is the burgeoning use of plastics. In 1967 some one-quarter of all American plastics were used in the buildings industry —some 3.7 billion pounds; and by 1970 this is expected to rise to seven billion and increase at an even more rapid rate thereafter. The wide range of uses is exemplified by the Houston Astrodome, filled with plastics from its all-weather transparent dome to its rugged turf.

Prefabs or mobile homes tend to come in traditional construction, sometimes with Du Pont's "Tedlar" plastic film to protect roof and siding. Du Pont finds that this polyvinyl fluoride retains at least 50 percent of its tensile strength after 25 years and erodes one percent or less a year on the sidings.

The Westinghouse Corporation teamed up with Hanley Structures, Inc. to produce factory-built schools. Mass production and systems engineering combine to cut the cost to

Steel is being used more and more in home construction. Post and beam foundation for a house is put up in just 15 days. Basford, Inc., New York, N.Y. developed series of houses called "Style in Steel Townhouses" using simplified methods.

a third or even a half less than conventional schools and can be installed in 24 to 36 hours. There can even be a brick exterior—this brick facing, about a half-inch thick, is screwed into place on the exterior walls. Mortar is applied after the building reaches its site.

The most radical innovations in construction are found in Europe—a line of weekend flying saucer homes available in Finland. The sections are put together on the spot and are all plastic—fiberglass reinforced polyester, acrylic windows and polyurethane insulation. Even the furniture is plastic. The architect, Matti Suuronen, the engineer, and the manufacturer come from Helsinki. Then there's a "Yellow Heart" providing a pulsating environment for two on a weekend. Suspended in a hammock-like bed, two can spend the weekend in this expandable Viennese prefab of pneumatic welded polyvinyl chloride, with electric pulsating units.

Coming back to earth—almost—architect Gerard Grandval has produced a plastic and plywood ski lodge projecting out of the snow-covered Alpine slopes above La Plagne, France. Built like a boat, its plastic roof, two bedrooms, kitchen, bath and bar (kitchen and bath are separate prefab units) come in 40 prefab units which can be bolted together on its cantilevered concrete foundation in only four days. It comes complete with a planked interior and built-in furniture with bookcases, expansive windows and electric heating. The cost including the furniture is said to be about $11,000. In Franconville, near Paris, French school children, working after school, assembled 100 components into two houses to make a youth center for themselves—in a week's time.

Probably the most famous plastic building in the United States was the House of Tomorrow built over ten years ago in Disneyland. More than 20 million people have passed through the house with no noticeable wear of its plastic skin. When

the house was torn down in 1967, it took the wreckers two weeks—instead of one day. Their 3000 pound steel demolition ball simply bounced off the plastic building; they finally had to crush the house with special choker cables.

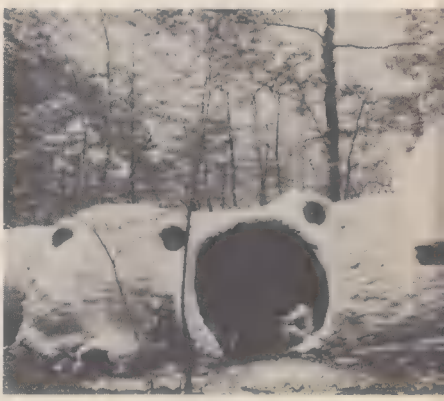
But American architects, too, have been turning to plastics for new building materials. Among reported projects are prefab lightweight room units suspended from a cental tower, plastic buildings that will look like a series of inverted umbrellas bolted together and supported by steel columns, inexpensive plastic foam walls that will harden to a higher tensile and compressive strength than concrete.

In November 1968, the Museum of Contemporary Crafts suddenly became the home of plastic foam, rigid urethane.

Three architecture students in their third year at Yale created an actual structure within the museum. They sewed burlap fabric together with hand-held sewing machines, inflated the resulting balloon and then sprayed a layer of plastic urethane foam, two to three inches thick on the outer surface. The foam dried within minutes and was sawed into segments, rearranged and fused together with more foam. Doors and windows were cut in the material whose light tan color and rough texture form a pleasant-looking and feeling structure.

Professor Ralph Drury of Yale's School of Architecture foresees the likelihood of similar systems soon producing habitable enclosures. California designer Douglas Deeds, director of design for architectural fiberglass in Los Angeles, sees design possibilities as practically limitless, for the foam fabricates and constructs itself at the same time. He believes that with improved technology, plastic foam would be a natural for mass housing in underdeveloped areas: you could move

Sculptured environment is achieved with sprayed urethane foam. Room (right) was designed by Douglas Deeds for Museum of Contemporary Crafts. Yale architecture students designed the house below.



the factory—several tanks of urethane—to the job site and grow the structures in practically no time.

Deeds himself converted the museum entrance into a cave by spraying everything. With no understructure, he produced shelves and seats, even niches in the walls, by spraying layers of foam, one on the other, and allowing them to harden.

The Ferro Corp. of Cleveland has developed a flexible plastic which is sewn into the desired shape and then inflated—the ultraviolet rays of the sun will harden the structure in a matter of hours. The developers have said that a half-mile dome might take eight to ten days to harden. There is talk of using these fiberglass-impregnated domes to

Fiberglas-reinforced plastics were used by American Standard in designing bathroom (above) with king-sized tub, sculptured wash basins and toilet molded into floor. Materials developed at Owens-Corning Fiberglas Corp. Futuristic bathroom design (below) by James Fulton uses Fiberglas-reinforced plastic to make what he calls "the most neglected room" in the house safe, functional and sleekly beautiful.

cover cities in a sort of bubble-gum effect, even for use on the moon.

Every day, vinyl piping is becoming one of the fastest-growing products on the plumbing market. George Fowles, marketing vice president of B. F. Goodrich's Chemical Division, says vinyl plumbing will become the most widely used material in its field within 10 years. He tells how Goodrich first introduced the material as water service pipe aboard a U.S. Navy minesweeper; then several million pounds went to the Navy for pipe in salt-

(Continued on page 53)

Goblet or profiles? Which do you see?

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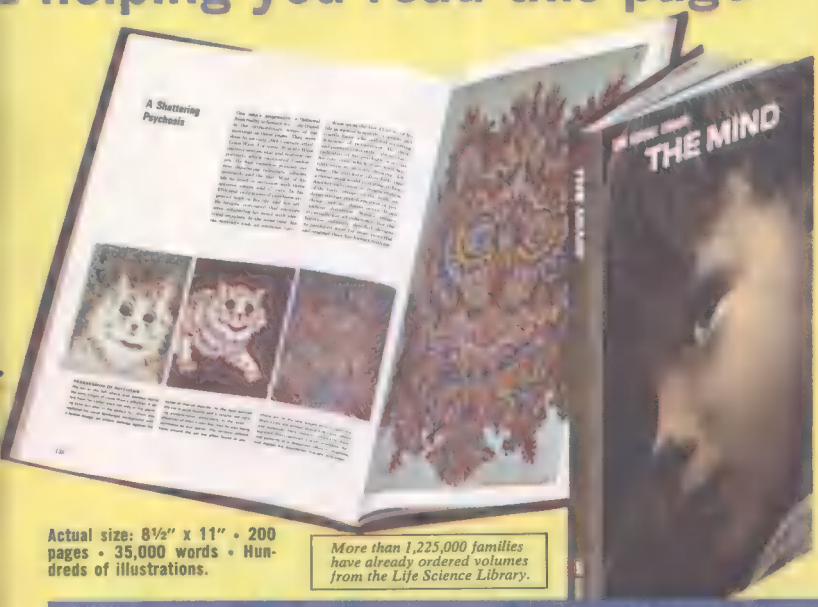

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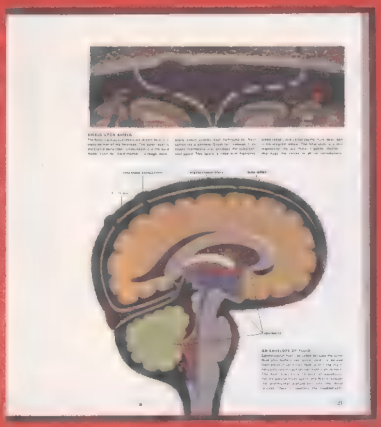

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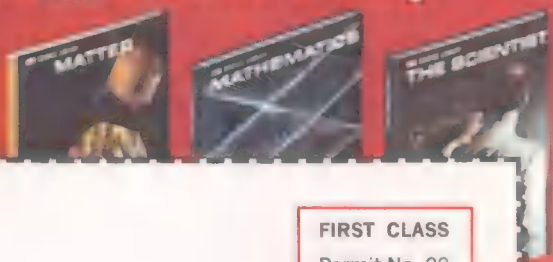

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water washdown systems designed to prevent contamination of ships' personnel from nuclear fall-out. About 325,000 civilian installations were made in 1968 for drain-waste-vent systems, and Dixon forecasts a half-milion in 1970 and twice that by 1975. Meanwhile chlorinated polyvinyl chloride is growing in use for water-distribution piping with an expected 300,000 installations in 1968 and over double that annually by 1975.

The introduction of fiber glass-reinforced plastics (FRP) into construction was a major step forward. The first use of glass fiber was at Chicago's Great Columbian Exposition in 1893. Silk then sold for $1.25 a yard, this new fiber—$25. But one visitor to the fair, the Infanta Eulalia of Spain, was so captivated by the stiff new cloth that she demanded ■ dress of it and triumphantly took it back home with her. Ordinary visitors to the fair hurried to see the "Hootchie-Kootchie dance" of "Little Egypt" only to be disappointed in the glass dress which was not only unattractive but opaque as well.

FRP is used in many ways in construction today, but the most challenging is a new concept of a systems or modular approach to total room design. Cornell University joined in a study of this approach to the bathroom. There will be molded sculptural FRP pieces to combine functions. Toilet and sink are integrated with the vertical partition wall, and storage areas are molded into the walls. Edward P. Lindsay, Owens-Corning Fiberglas' manager of FRP products, predicts that a large percentage of complete bathrooms as well as individual fixtures will be FRP—one out of every three bathrooms installed by 1975 in America will include this plastic.

Unit bathrooms are already available—you can select the entire room with all its fixtures from a catalog of a variety of models and colors. It can then be carted home and dropped into place. All that's needed is someone to hook the plumbing and electricity to your house lines. Borg-Warner's Plumbing Products Division has introduced a production-line one-piece bathroom-kitchen core unit. The exterior walls of the 3,390-pound unit will be of sandwich steel panels filled with polyurethane foam. It will be delivered ready to connect to the building's lines. The unit contains not only the lighting for both rooms, but the fuse and junction boxes for the entire dwelling.

This same FRP produces Owens Corning's "Quiet Room" concept. By means of monocoustic ceiling panels, staggered stud wall construction with fiberglass insulation and gasketed doors, rooms or entire houses can be sound-conditioned. In the foreseeable future, this will probably become a feature home buyers will insist upon, as today they demand air-conditioning.

Steel too has entered home construction. As Ray Watt, one of the country's largest and best known builders, puts it: "Refinements in technololgy and product lead me to

believe that steel is going to take a much bigger share of the market in home-building." One example is steel fiber-reinforced carpeting to eliminate the static electricity and make the carpet last longer.

Then there is the exciting new "weathering steel"—with all the advantages of conventional carbon steel such as good workability and weldability, it has nearly 1½ times the strength of conventional structural steel and greater resistance to abrasion and impact. And it never needs painting.

First introduced by one of the world's greatest architectural innovators, the late Eero Saarinen, and his partner, John Dinkeloo, in the John Deere Building in Moline, Ill., the material has now attracted many architects for its changing tones on exposure to the elements. Dinkeloo studied the corrosion graphs of many steels until he found one which over a 15-year period developed a hundred subtleties of color. Bolting and riveting can not be used because the accumulation of water around the bolt and rivet head would produce staining and streaking—the run-off of rusty water also must be handled properly for this reason.

Time, degree of exposure and environment all influence the appearance of the steel and the rate of weathering. This is a metal which heals itself. As the steel oxidizes, it actually locks out further corrosion and its color deepens to a final rich deep-brown oxide coating, about the same thickness as a coat of paint. Architects are now turning to this material for residential building as well as industrial, even for bridges.

Pittsburgh Plate Glass (PPG) has introduced the first ⅛ inch thick safety glass for homes. It is another member of the Herculite K family of fully-tempered safety glass which usually bends with a heavy blow, in contrast to ordinary glass which just breaks. When Herculite does break, it "breaks safe" into small fragments without sharp jagged edges.

PPG has also introduced a new high-temperature low-expansion glass ceramic. Shock-resistant, it can even hold that old-fashioned iron skillet safely. Translucent or opaque, it has designs to indicate where the heating elements of the stove are, and can be used on the modern high-speed ranges, whether gas or electric. If something spills from a pot on this solid cover of the range top, there's only a sheet of glass to wipe off.

Westinghouse Corporation will soon market a unique light bulb described as the most efficient compact light source today. It's a discharge-type lamp similar in principle to the mercury vapor lamp, but this new bulb contains sodium metal sealed in a small ceramic arc tube. The scientists had to use more than a dozen different metals in this Ceramalux sodium light bulb.

The new lamp produces 105 lumens per watt (lumens are a measurement of the quantity of light produced) as compared to 52 for an ordinary mercury vapor lamp and

17 for your incandescent household bulb. Small in size as compared to mercury lamps, a 400 watt lamp is only 2¼ inches in diameter and 9¾ long. The average rated life has tentatively been set at 6,000 hours although it is expected to be much more. The light is of a distinctive golden cast but is satisfactory for industrial illumination, street lighting, parking areas and floodlighting.

Meanwhile, a silicone rubber coating has been used to eliminate the danger of flying glass from broken bulbs. These "Safe-Line" lamps stay intact even after hit with a hammer. The coating causes only 0.5% loss of light as compared to conventional lamps. It is valuable in areas where there may be rough handling, as in home workshops, construction sites, machine shops, garages and other situations.

The importance of these new building materials is clear from the estimate of R. Wayne Nelson, director of urban planning for Westinghouse Electric Corporation, which foresees that by the year 2000 we may need 500 new cities each with a population of 100,000 to 200,000.

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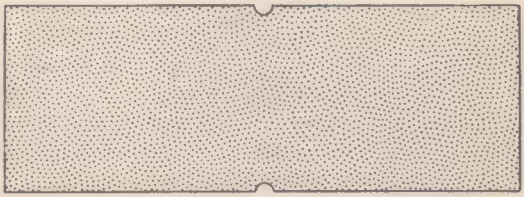

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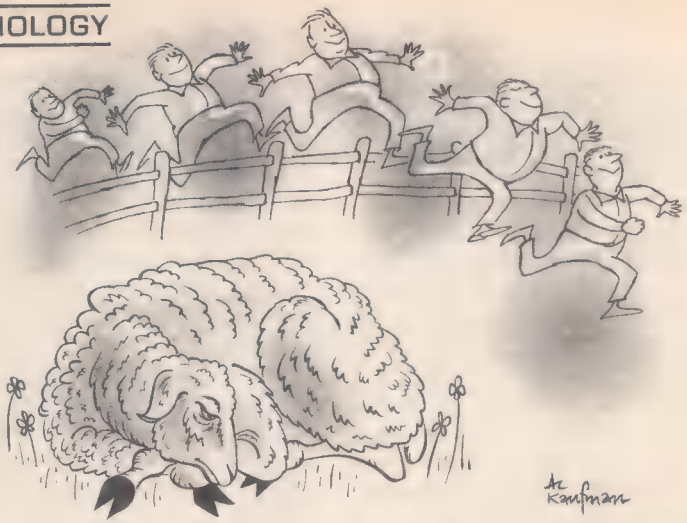


Do sheep count people when they can't sleep?

A child's innocent question prompted this writer to find out just what happens when sheep are asleep—if they do indeed sleep.

by Leo J. Wilhelm

EARLY LAST SUMMER, while my eight-year-old nephew, Jim, and I were admiring a lamb and its mother in the domestic animal section of Crandon Park Zoo, near Miami, Fla., he asked suddenly—and innocently—"Do sheep count people when they can't sleep?"

I barely had time to answer with an amused "No," when he followed with, "And do animals get insomnia, like people do?" To this, I answered that I wasn't sure.

But it got me to thinking and probing on the sleep patterns of animals. And my findings were both fascinating and fruitful.

Extensive scientific research and observations on sleep, both in the United States and Europe, have been made on animals as well as humans. What is sleep? When are you in deep sleep and when are you sleeping only lightly? How do these phenomena apply to animals? Do animals experience paradoxical sleep—which is akin to dreaming in people?

Experts fail to agree on an exact definition of sleep. They generally agree, however, that an animal which fails to react to certain stimuli and to significant events in its environ-

ment, with an accompanying relaxation and loss of consciousness and vision, and which must be aroused to a state of wakefulness, is asleep.

The physiology of sleep produces many changes. Blood pressure and pulse rate may decline; breathing may be slow and regular, and there may be a noticeable muscular relaxation and a disappearance of deep reflex actions. Even without these signs, there is often normal sleep.

By noting the activities of animals and fowl, it was possible to determine those that experience sleep in one phase, such as horses, and those whose sleep comes in two or more phases, such as sheep, during a 24-hour period. Horses are active during the day and rest and sleep at nighttime, while sheep sleep briefly several times a day with their rest periods broken by periods of activity.

Animals and fowl come within one or the other of these two distinct sleep classifications. Those that depend largely on their senses of touch and smell belong to the second class, with their sleep coming in multiple and brief episodes, interspersed with intervals of activity. Birds, which rely on optical stimuli, do their sleeping in one phase, without frequent interruptions.

In the lower animal kingdom, as in man, sleep doesn't develop instantaneously. There is an onset period. It may vary, but generally it's marked by lassitude, a drooping of the eyelids, and a seeking of a comfortable position for relaxation and rest. When this condition is accompanied by complete absence of consciousness of significant environmental events, the animal is usually considered to be in a deep sleep. On the other hand, the sleep may be only light or transient, or attuned to certain stimuli, as where a mother animal awakens instantly at the sound of her child.

Until recently, it was believed that some animals, especially ruminants, slept little if at all. Ruminants are characterized as even-toed hoofed mammals who chew the cud, such as sheep, cattle, deer, camels and giraffes.

Sleeping and chewing

Observers believed that they didn't sleep because they rarely closed their eyes, and even when they did they seemed not to lose consciousness. Further, only rarely were they observed to lie out flat, even though they frequently did lie down. Another reason was that they spend much of their time ruminating—chewing the cud. This requires the animal to keep his thorax and head in an upright position and requires a considerable degree of consciousness. To most earlier observers, this seemed to preclude typical sleep.

Experiments were undertaken in 1965, by Iowa State University, at Ames, under a National Institutes of Health General Research Support Grant, to establish whether this type of mammal has the physical capacity for sleep and whether the characteristic of frequent ruminat-

ing was sleep-inhibiting.

The experiments were conducted with goats. During the experiments, their physiological functions were carefully monitored by an electroencephalogram (EEG), an electromyogram (EMG), an electrocardiogram (EKG), plus other electronic recordings. Carefully chosen drugs (atropine and chlorpromazine) were employed to test the sleep-inhibiting influence of rumen contraction. Frequent observations showed also that the goats sometimes rested their heads on their flanks—often in a lying position.

Catnapping for goats

The conclusion was that ruminants, such as goats, do have the capacity for true sleep, although the sleep is of a transient nature and comes in numerous episodes. Each of these episodes is of short duration, varying from a few seconds to a few minutes. Some days the animals don't sleep at all, while on others they have as many as six sleep episodes. Moreover, it was also determined that although rumen function doesn't prevent sleep, it actually doesn't occur during sleep.

During the sleep episodes, it was observed that the animals' muscles were relaxed, their heart rates were slower and there was a noticeable closing of the eyes and a drooping of the head.

Many 24-hour observations have been made of sheep and cattle, and automatic recordings of their sleep-behavior patterns have been successfully conducted. An especially interesting experiment was made at the Aberdeen University Farms in Scotland in 1956, using 18-month-old tame sheep.

Since sheep are very easily disturbed after dark, it was necessary to start the observations during daylight without disturbance and then after much patient effort continue them into darkness. To make it possible to observe the sheep without disturbing them during darkness, a dim red light was employed which simulated the approximate intensity of moonlight.

Recordings of respiration rates during a July through September period varied around 80 per minute, although this rose to as high as 140 during hot, thundery weather. On many occasions, especially at night, periods of deep, regular breathing varied from 21 to 39 respirations a minute. During these observations, the sheep spent up to 38 minutes lying quietly and in a relaxed position, with their eyes also closed.

To determine whether or not the sheep had lost consciousness during these periods, several stimuli were employed, such as flashlight photography. Unless aroused by touch or sudden noise, the sheep did not react to the observer's close approach, nor even to the camera flash.

Sheep have an extreme liking for chocolate. During their upbringing, the tame lambs had been taught the habit of responding to an offer of tidbits. During the test periods, while in a state of apparent sleep, they failed to respond. They were

Sheep not only sleep; there are signs that they may even dream—paradoxical sleep.

also observed to sleep in many different positions. However, upon being aroused they immediately investigated the stimuli used and began eating the chocolate offered.

Photographs taken showed the sheep apparently falling asleep just before their failure to react to the various stimuli. Although they failed to respond to certain stimuli when used singly, such as the camera flash, they did respond to a combination of sound and vision stimuli, such as the striking of a match and then the camera flash. This usually aroused the animal suddenly.

Many signs show when a sheep is falling asleep. A sheep will stop feeding, stand idle for a few moments then take a few steps, go to its usual sleeping place and lie down, "chew the cud" with its eyes closed and yawn. Usually at this point it falls asleep. The pattern sometimes varies, but there's now good evidence that a sheep sleeps, sometimes many times during a night and occasionally during the day.

Unlike a horse, which may lie down stretched out and sleep as much as seven hours during a 24-hour period, often uninterruptedly and usually at night, a sheep's sleep pattern is one of a series of episodes, interspersed with periods of activity.

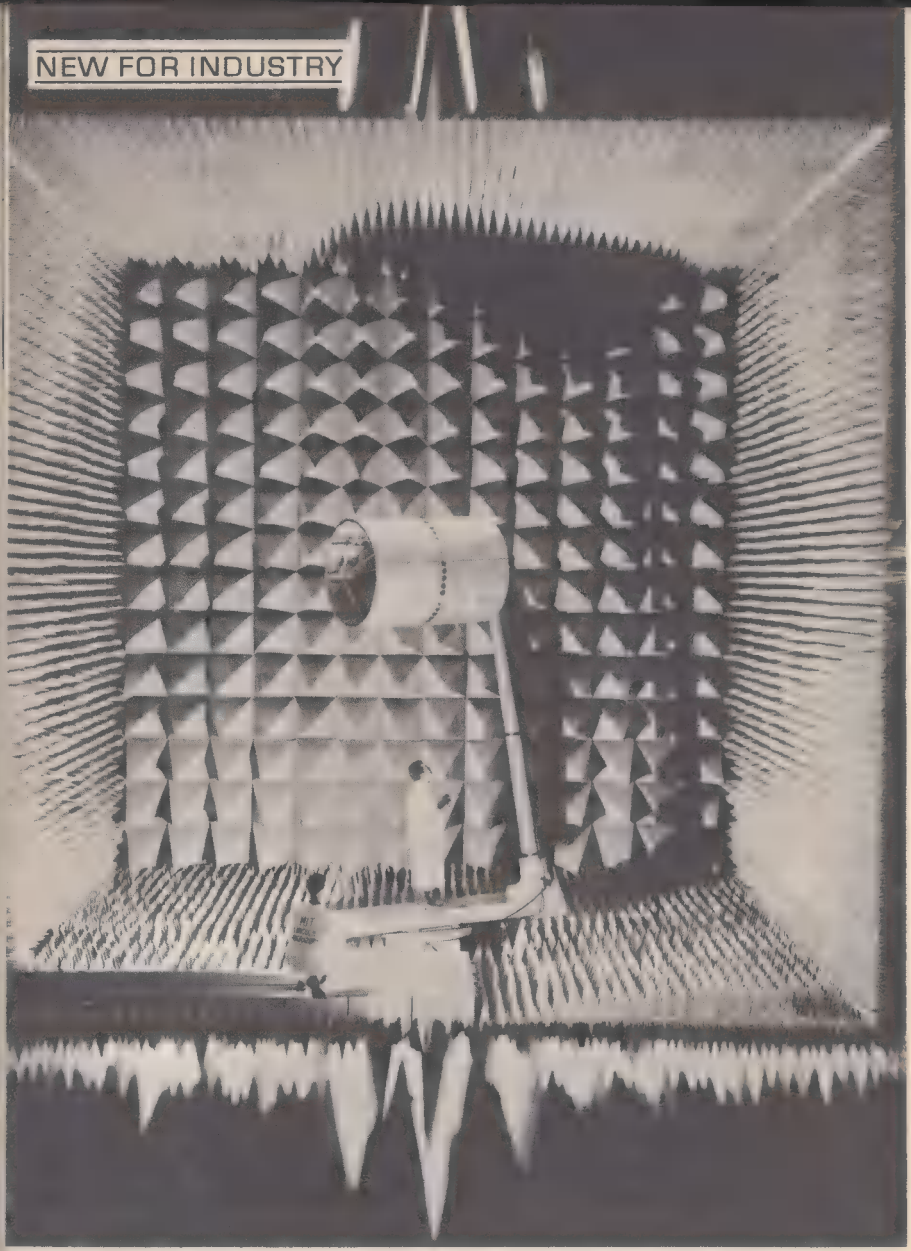
Sleep patterns in animals have intrigued experts for a long time. And an interesting related factor is whether animals dream.

In the Iowa State University experiments, PS—paradoxical sleep—which is akin to dreaming in man, was observed in all the goats studied. These observations followed episodes of *typical* sleep and usually ended with sudden awakening.

In all the cases studied, all the criteria for PS were present. In addition to onset after typical sleep, these included a twitching phase of the ears, limbs and facial muscles, and a quickening of the pulse and respiration. It was noted that while these rates rose during PS over what they were during true sleep, they were lower than during full wakefulness. The episodes of PS were similar in duration to those for typical sleep, sometimes lasting only 25 to 30 seconds.

PS had previously been observed in man, chimpanzees, cats and some birds. This discovery that ruminants also experience PS increases considerably the speculation that "dreaming" is widespread among higher animals. Likewise, whether insomnia affects animals similarly as it affects man is speculative.

When he reaches manhood, this may be a project my inquiring nephew, Jim, may want to pursue, as well as a fuller answer to his first question, "Do sheep count people when they can't sleep?"



Antenna test model of LES-6 experimental communication satellite is in microwave anechoic chamber at M.I.T. Lincoln Lab, Lexington, Mass. It will aid in development of satellite communication system.

Light tube (right) permits reading remote objects by carrying image from one end of tube to other, giving ¼"X¼" picture. Series 3000 Graphic Image Light Tubes, Van Deusen Co., Laguna Beach, Calif.

World's most powerful jet engine recently exceeded 63,200 pounds of thrust. Four of these GE4 turbojets, by General Electric, will power the SST being developed by Boeing.

Videofile system (below) reduces conventional files to compact magnetic recordings. If copy is wanted, printer in foreground converts signals to facsimile. The Ampex Corp., Redwood City, California.

Experimental optical memory system (above) directs laser light to holographic plate which can store 100 million bits of information on nine square inches. Information is then computerized. By IBM.

High voltage generator (below) can produce five trillion watts of power. Called Hermes II, the machine was built to simulate gamma radiation by Sandia Lab in Albuquerque, N.M., for Atomic Energy Commission.

Static electricity—

space age gremlin

by Edward A. Lacy

BACK BEFORE the Gemini experiments, space engineers believed that a spacecraft could acquire a substantial charge of static electricity from rubbing against the atmosphere on the way to space and from engine operation in space. Such a charge might destroy sensitive semiconductor circuits, they reasoned, or cause a circuit to turn on at the wrong time. Naturally, the engineers were greatly relieved when the static discharge monitor on the Agena told them that static electricity is not a problem in space.

But while it may not be a problem in space, this billion-year-old gremlin nonetheless presents difficulties for the space age and particularly for the missile industry. At

Cape Kennedy, for example, no one wants to be working around live missiles when lightning—a form of static electricity—is nearby. In 1965, one of the launch gantries was hit by a stroke registering 151,000 amperes.

As dangerous as such strokes may be, even a slight discharge can cause disaster, as the missile engineers have learned from tragic experience. For instance, early one spring morning in 1964 at the Cape, technicians and mechanics in the spin-test facility were preparing to move the third stage of a NASA Delta rocket. Someone had just removed a protective plastic sheet from the motor when the motor suddenly ignited, lifted off and flew to the end of the 100-foot-long building. Five men were burned critically (two later died) by the 3000° exhaust from the motor. The suspected cause of the whole affair: static electricity from the protective plastic cover.

Fortunately, when ordinary folk encounter static electricity in everyday situations, the results are not so tragic. On dry winter days we may get a tingle or perhaps a jolt if we shuffle across a carpeted floor and touch a metal desk, or doorknob. Self-protection is simple: slap the metal object with the palm of your hand before attempting to use it, or touch the doorknob with a tightly held key.

Electronics enthusiasts have long been familiar with the problems of static electricity in phonograph records, transistors, instruments meters and automobile tires.

It is no secret, for example, that the plastic used in phonograph records can be given high static electricity charges which, unfortunately, attract dirt, dust, and fluff to the grooves, causing noise and distortion as well as damage to the records. The problem has become even more acute with stero records and with modern pickups which track so lightly that they ride over the dust particles instead of pushing them aside.

What are the record manufacturers doing about the problem? One company has added an anti-static agent, Catanac SN, to its high quality records to stop the problem at its source. Another major manufacturer says such agents are costly; still another claims that the use of sufficient additives to eliminate static electricity causes the sound quality of the records to suffer.

Additional electronics problems with static electricity involve transistors. Some years ago it was noticed that when transistors were inserted into Styrofoam blocks for temporary storage, the very act of pushing the leads into the Styrofoam sometimes generated a static charge great enough to destroy the device.

In most cases, static electricity is generated by friction. When the plastic face of a test instrument is polished, for example, enough electricity may be created to attract the needle of the meter to the face

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and result in an inaccurate reading.

However, static electricity can be produced by electrostatic induction and by contact and separation of materials. In the latter case, electrons may move from one material to another, as when belts pass over pulleys or when automobile tires run on highways. If the materials are then separated, one object will have a surplus of electrons (negatively charged) and the other will have a deficiency of electrons (positively charged). A surface is considered to be strongly charged if it has a deficiency or excess of only one electron in 100,000 atoms.

A static charge may have a potential from a few volts to several hundred thousand. Since the human body can develop up to 10,000 volts under certain conditions, it is not uncommon to find charges measuring from 5,000 to 10,000 volts in a simple doorknob discharge!

Body electricity

A static voltage as low as 1,500 volts can be felt if the little finger is slowly and carefully brought to within a few thousandths of an inch of a charged body, says the Bureau of Mines. Why, then, don't such high voltages cause serious injury or death? Simply because the current is so small. The Bureau explains it is follows: A current of half an ampere is needed to light an ordinary 4.5-volt flashlight to full incandescence. It would require 500,000 people, charged to 5,000 volts each, to hold that output.

The static electricity on one's body may be enough, however, to ignite highly flammable dusts, gases and vapors.

Annual fire and explosion losses from static electricity have been estimated as high as $100,000,000. This figure takes into account such diverse explosions as those in hospital operating rooms, munitions factories and airliners. For example, an inquiry board concluded that the 1959 crash of a *TWA* plane in Italy was caused by a gasoline explosion touched off in flight by static electricity.

Lightning causes many explosions and fires. As a tremendously powerful static electricity spark, a single bolt may have a potential of 100 million volts and produce a current of 200,000 amperes. Such bolts are classified as either "hot" or "cold." A hot strike lasts up to a tenth of a second and sets fire to flammable materials in its path, while a cold strike is faster and has an explosive rather than an inflammatory effect.

The lightning-protection has gone undercover with much of its equipment. Five-foot-tall lightning rods with ornamental colored glass balls have given way to 10-inch-tall "air terminals" which may be the only parts that show in a modern system. The conducting cables to ground are hidden from sight.

Does a grounded TV antenna provide lightning protection? No, says the Lightning Protection Institute, which is sponsored by the lightning protection industry. The Institute says that the average an-

tenna does not have a long enough ground wire and does not have enough paths to ground. Ordinary antenna grounding, the Institute states, protects against accidental energization from electrical service, but it cannot be expected to ground lightning, which has an amperage that may be more than a thousand times greater than ordinary house current.

To eliminate or control static electricity, it is necessary to use sensitive instruments to detect and measure it.

The simplest of these, often seen in elementary science demonstrations, is the gold-leaf electroscope. In this device, the gold leaf is attached to a metal rod. When the rod is brought near a charged body, the leaf is repelled from the rod (or itself) because like charges repel each other. With the electroscope, charges as low as 350 volts can be detected.

A neon lamp or fluorescent tube also can be used to indicate the presence of static electricity, since it will light feebly near as small a discharge as 100 volts if one terminal is grounded or held in the hand. Even a burned-out fluorescent tube works.

Electrostatic voltmeters are employed to measure very high voltages such as those encountered around radar, oscilloscopes and Van de Graaff generators.

Once a static electricity problem has been detected and measured, it can be controlled or eliminated by a number of simple methods.

One of the most powerful forms of static electricity, lightning, is dramatically illustrated above, and a common type of charge below. Induced static charge causes ashes to leap to record at right; left one has been treated with anti-static chemical.

When two (or more) conducting bodies are connected together with a conducting wire, there will be no potential difference between them and static can't occur. In this condition, the objects are said to be bonded. But they may still have a potential compared with ground.

By simply connecting a wire from the objects to ground, they become *bonded and grounded.*

Since static electricity currents are measured in microamperes, the heavy, fast-conducting grounds required in electrical work are not needed. In fact, in hospital operating rooms, where anesthetic gases can be ignited by a spark, such low-resistance grounds are deliberately avoided. The floors in these rooms are made just conductive enough to drain off static charges, but not conductive enough to be a standard electrical hazard.

During winter months when the relative humidity goes down, static electricity becomes obvious, especially when one walks across a carpet and touches a metal doorknob. On the other hand, during the summer when the humidity is high, static electricity may scarcely be noticed.

When the humidity is high, some materials may absorb moisture, become more conductive, and thereby allow static charges to leak off.

At one time it was thought that this high humidity could be used to reduce the hazards and nuisance of static electricity. Thus, in some factories and hospital operating rooms, the humidity was raised to 70 percent. Not only was this hard on the workers, but it didn't work well enough to make it worth the cost and discomfort.

Radioactive static eliminators are another effective system. They use radium or polonium to ionize the air. While such devices offer safety from explosions, they are a radiation hazard to anyone working nearby, and must be shielded.

High-voltage eliminators work differently. They apply 5,000 to 15,000 volts to a series of points close to a grounded surface. The voltage across this gap will discharge most charged items that are placed in the gap.

Static combs are grounded metal bars with needles or wire brushes. When a charged body (such as a flow of paper on a press) goes by such a comb, the charged body ionizes the gap between it and the comb, thereby discharging itself.

Anti-static sprays frequently are employed in the hand-held air guns used for cleaning plastic parts.

Nowadays, anti-static sprays are used to apply a chemical coating which forms a conductive surface. The anti-static agents can be incorporated directly into plastics.

With all its faults, can anything good be said about static electricity? Yes. It is being put to work in Van de Graaff generators which are used in atomic research.

And in electrostatic painting, paint droplets are deliberately given an electrostatic charge as they pass through an atomizer. Since the paint then tends to converge on the item to be painted, it simplifies the job of painting the back sides of cylinders and knobs. Also, very little of the paint is lost in the process; some electrostatic paint installations claim that paint consumption is 30 percent that of a standard painting installation.

Loose knees and football

by Arthur J. Snider

BECAUSE OF THE epidemic of knee injuries to professional football players during the 1968 season, many medical experts are considering ways of combatting the problem.

Dr. Theodore Fox of the Chicago Bears, who lost their famous running halfback, Gayle Sayres, says team physicians of both the National Football League and the American Football League have organized into a medical association for the purpose of making recommendations.

"Doctors were influential in bringing about rule changes on grabbing the face mask and in calling a play dead when one knee hits the ground," he said. "We feel we can be of help to the owners and the commissioner's office in recommending other changes in rules or equipment."

Dr. Thomas Peterson, University of Michigan orthopedic surgeon, believes the cross-body block in which the player throws his body in a horizontal position, should be eliminated. "The effect on a player's knee is like being hit with a railroad tie," he said.

Dr. James Nicholas, team physician for the New York Jets, believes closer examination of players to eliminate those with "looseness in ligaments" will yield advantages. "We reviewed 36 ligament cases over nine years and found 30 players had been classed as having loose joints before they got hurt," he said.

Dr. Nicholas is among a growing group of observers who believe the ultimate answer may lie in synthetic turf. Dr. Allen Ryan of the University of Wisconsin shares this view.

"We played on synthetic turf during the last football season, and our knee injuries were much less severe than in previous years," he said. "Instead of getting knees that require surgery, we are getting knees that respond to conservative treatment. The same is true of ankles."

A survey of knee and leg injuries among 542 colleges and universities by the Monsanto Co., makers of the synthetic Astro-Turf, showed that 1,771 occurred in 1967. If this survey were extrapolated to the entire membership of the NCAA, the total would be 5,190.

The odds were 1 in 8 that the average football player would suffer a serious leg injury in any given year and 1 in 2.4 that he will have such an injury sometime during his four years of college football play. The data showed the odds were reduced more than 50 percent for those who played on Astro-Turf.

Why is football seeing a growing number of knee injuries? The increasing size and speed of football players. It is pointed out the human

knee is a marvelous, single-action hinge. It moves two ways—back and forth, like the hinge on a backyard gate. It is ideally suited for walking, running or swimming. But nature never envisioned the day when man would engage in violent football, a game in which one group of people expends vast amounts of energy trying to move others sideways. If nature had envisioned football, she probably would have built the knee like the multiple action swivel on an office chair.

Nature has lashed and bound the knee with tough bands of ligaments and further supported it with shock-absorbing cartilage. One of the body's biggest and strongest musles, the quadriceps, travels down the front of the thigh through the knee joint for further support.

Because the knee is built that way, it is vulnerable to the particular violence of football. The injury commonly occurs when a player is hit while his cleats are dug deeply into natural sod. On impact, his body turns. But his feet do not. Not equipped to bend to the side, the knee joint strains and pops.

In 1967, the average National Football League squad had 4.5 players unable to play for each game, and in 70 percent of the cases, injuries to the knee were responsible.

At the University of Missouri, a questionnaire was sent to 350 former members of the football squad. Of those answering, 51.2 percent reported they had suffered at least one knee injury while playing or practicing.

Hints for heart patients

In 1961, the American Heart Assn. called for reduced fat consumption combined with reasonable substitution of vegetable oils as a means of reducing the risk of heart disease.

In 1965, the AHA recommended for the first time reduced intake of cholesterol rich foods.

Now it has made even a stronger statement on reducing saturated fats and cholesterol consumption and has called upon the Food and Drug Administration to permit accurate labeling of vegetable oil products to help consumers identify those brands most effective in lowering cholesterol levels.

There is difficulty in distinguishing between a product made with vegetable oil but heavily hydrogenated (saturated) and one retaining a high content of polyunsaturates in the final product," the AHA said.

"Since 1961, many manufacturers have made a substantial effort to increase the polyunsaturate content of vegetable oil shortenings, the l i g h t l y-hydrogenated salad and cooking oils and especially the tub-type margarines. Accurate labeling would make it possible to identify the brands with a high-polyunsaturated fat content.

"For the present, margarines that

are high in polyunsaturates usually can be identified by the listing of a 'liquid oil' first among the ingredients. Margarines and shortenings that are heavily hydrogenated or which contain coconut oil, which is quite saturated, are ineffective in lowering the serum cholesterol."

Next: voice transplants

The larynx, or voice box, has been transplanted from one dog to another by surgeons at Washington University, St. Louis. Deprived dogs regained their barks and growls.

Dr. Nicholas J. Cassisi says the operation can be done on human beings when the "rejection barrier" that now plagues heart and kidney transplants can be overcome. He says about 35,000 Americans are prospective candidates for transplanted voice boxes and their number grows by about 5,000 a year. Most of the voice boxes are removed because of cancer. Many of the patients have regained a form of speech by manipulation of the windpipe, but it is an unnatural and difficult way of speaking.

Blood pressure bypass

By removing the artery that supplies blood to the spleen and transplanting it to the kidney, a form of high blood pressure has been corrected in animals. The surgical technique is now ready to be applied to human patients, according to Dr. Harry S. Goldsmith of the Memorial Hospital for Cancer and Allied Diseases, New York.

He estimates that about one million Americans suffer from the form of high blood pressure in which an insufficient amount of blood reaches the kidney.

Nine-month follow-up studies on the animals have shown that all have maintained their reduced blood pressure.

Baby monitor sounds alarm if breathing trouble should develop. Tiny sensor and radio transmitter near infant's neck is a "stand-in" for full time nurse. NASA. U.P.I.

Coffee break smoke trap

Trying to quit cigarettes? Take a walk instead of a coffee break, advises Dr. Robert B. Shira of Washington, D.C. The mid-morning pause at the coffee counter is one of the strongest influences in smoking. There also is a strong association with cocktail parties and social drinking, he says.

"Advertising in behalf of cigarettes also may be a reminder," Dr. Shira adds, "but not nearly as strong as sitting near a friend lighting your favorite brand."

Artificial cornea is implanted with success by Dr. Bernie Zucker on Gordon Sheppard at Scarborough Hospital, Toronto, Canada. Sheppard had been blind for 22 years and hopes for full vision. U.P.I.

For those who cannot quit overnight, Dr. Shira has this suggestion: "Buy only one pack at a time. Carry it in a buttoned pocket. Don't carry matches or a lighter. Have handy substitutes for cigarettes, such as sugar-free gum or candy."

He concedes that an increase in weight is likely to occur since the taste buds sharpen after cessation of smoking. "If weight can be maintained, fine," he says. "If not, it will be easier to taper down on food consumption after the smoking is under control."

Dr. Shira drew a parallel between the abstaining ex-smoker and the ex-alcoholic. "Each will rationalize that one cigarette or one drink is harmless," he said. "But after all, a pack of cigarettes is merely 20 single ones."

Studies are showing the most dramatic change in those who stop smoking is elimination of chronic cough.

Nose spray stuffiness

People with stuffy noses and post nasal drip who resort to constant use of sprays can turn themselves into a "nasal medication addict," cautions Dr. Roger A. Simpson of the University of Iowa medical school.

Persistent use of intranasal medication can cause a "rebound phenomena" in the lining of the sinus cavities. The lining shrinks when the spray medication is applied, relieving the stuffiness; but when the effect wears off, the membrane tends

to swell even more than before. More medication is used and more rebound swelling ensues.

Usually the problem can be remedied by discontinuing use of the medication, he advised.

Automated injections

Bedridden patients recovering from surgery can give themselves a shot of a pain-killing drug at will by electronically activating a syringe. Dr. J. M. Fernstermacher of Baylor University told the American Society of Anesthesiologists that patients are enthusiastic about the device because they know relief is promptly at hand when they need it.

Four syringes are mounted at the bedside, but a timer prevents a second injection until a time interval selected by the physician has passed. Each injection is recorded on a graph. The patient presses a button switch. In Rube Goldberg fashion, the switch opens a valve which in turn allows gas pressure to drive a piston. This in turn empties the contents of a syringe into a manifold already hooked up with the patient's vein.

Dr. Fernstermacher says a careful record of pain relief has been kept on all patients using either a one-milligram or two-milligram dose of morphine. This baseline will provide a means of comparing the pain-relieving capacity of new drugs with morphine as they come along.

Another do-it-yourself technique, developed by Dr. M. Judah Folkman of Harvard University medical school, involves implanting a small piece of permeable silicone rubber tubing in the patient's wrist with a loop of the tube emerging through the skin. Controlled administration of low doses of pain-relievers by way of the rubber wristlet could be administered to the blood stream. Dr. Folkman said it might have advantages for terminal cancer patients, for example, who could be trained to supply their own pain relief at home.

Hong Kong flu vaccine in its first production step starts out as an injection of flu virus into fertile eggs. Up to 130,000 eggs are being processed each day to supply vaccine needed for the illness. U.P.I.

Laser beam printing

LASER BEAMS and lensless photography contribute to a new method of printing, recently patented by the Radio Corporation of America. It promises to enable a publisher to print and reprint books page by page serially, from title through index.

The system is called Laserfax by its inventor, Dr. Kenneth H. Fischbeck, a staff technical adviser at the David Sarnoff Research Center in Princeton. His patent is No. 3,410,203.

Among the predicted advantages, besides lightening publishers' inventory problems, are high speed and the absence of any impact, such as the usual pressure of plate against paper. The light-weight machinery should cut costs.

Double use is made of the laser's intense light. The copy, which may be a newspaper page, halftones or line drawings, is first photographed on a transparency. With the aid of a laser beam, this image is transferred to a hologram, or lensless photograph. Each hologram serves as a permanent plate for a single page.

As the paper on which the printing is to be done unrolls, a toner (powdered ink) is spread on it. A laser beam reflected from the hologram onto the toner melts it in the pattern to be reproduced, and the surplus grains of powdered ink are vacuumed off.

According to Dr. Fischbeck, when a correction is to be made the beam can be switched to a fresh hologram and it is unnecessary to stop the press.

Pages are usually printed repetitively and grouped in "signatures." Reproducing them serially should simplify filling reorders from the bookstores. As Dr. Fischbeck put it, a publisher could almost print on demand, without going through the elaborate arrangements now required for even a limited run.

R.C.A. has tested the Laserfax system in its laboratories at Princeton, but has not announced any production or licensing plans.

—*Stacy V. Jones*

Dr. Fischbeck demonstrates his Laserfax—laser beam strikes hologram, prints "A."

COLLEGES IN ACTION

Chimp human chit-chat

A YOUNG FEMALE CHIMPANZEE named Washoe is being trained to understand and transmit sign-language signals, to see if she can communicate with people.

Washoe's training is described in *Science* by Dr. Winthrop N. Kellogg, professor emeritus of experimental psychology at *Florida State University*. The ape lives in a furnished house trailer and hears no speech from the humans who come in contact with her. Instead, her trainers, Drs. R. A. and B. T. Gardner, and other humans communicate in the American Sign Language, a system in active use by the deaf in both the U.S. and Canada.

Dr. Kellogg points out that both chimpanzees and gorillas in the wild state use specific gestures and postures for communicating with other members of their bands. Laboratory experiments, too, indicate that chimps readily adopt characteristic attitudes as a means of communication. In contrast, chimpanzees learn a few human words only with great difficulty.

After 16 months, Washoe could use 19 signs reliably. Five more signs were in the developmental stage. A good many of these signs are standard American Sign Language signals, some are variants and a few are chimpanzee "originals."

"There is evidence," says Dr. Kellogg, "that she understands a great many more signs than she can use herself."

U.P.I.

Can a chimp be taught to talk to people? Yes, says a Florida psychology professor who is teaching one to speak sign language.

Among the signs Washoe uses are:

"Come"—beckoning with wrists or knuckles to persons or dogs, or for objects out of reach.

"Up"—pointing up with index finger when she wants to reach a high object or when she wants to ride on someone's shoulders.

"Hear-listen" — index finger touches ear for loud or strange sounds.

"Hurry"—shaking open hand at the wrist, a variant of an American Sign Language signal, which frequently follows signs such as "go" and "out."

"Sorry"—rubbing bent hand

across chest, another ASL variant, after biting someone, when someone has been hurt in some other way or when told to apologize.

Comments Dr. Kellogg: "The most significant thing about these gesture signals is that they are by no means confined to the names of specific persons or things. Some of them—for example, 'please,' 'hurry,' 'sorry'—are verbs and adjectives which apply in varying social contexts and are used effectively in different situations of the same class. As such, they are far in advance of all previous chimpanzee efforts to communicate with human beings."

X-raying the ocean floor

How can you tell where the ocean bottom is hard enough to support a research laboratory or an underwater hotel?

In a technique being used by the *University of Illinois,* industrial X ray equipment designed by the Picker Corporation analyzes samples of bottom soil. A squiggly line on the X ray means a worm burrow and a bottom too soft to support much weight. A delicate, flower-like pattern indicates the presence of sea shells and a harder bottom.

X ray equipment (above) analyzes soil sample from ocean floor to determine geological structure. Delicate, flower-like pattern (below left) indicates presence of sea shells and a hard bottom. Squiggly line (below right) means worm burrows and a soft and unstable ocean bottom.

Samples are usually collected from depths of 800 to 18,000 feet, a few from 30,000.

The University team gets the samples by ramming a 10-foot-long plastic tube into the ocean bottom and pulling it back into the ship. The tube is cut in two and the ends sealed to keep in the moisture. Back at the laboratory, the material from the tubes is measured for "shear strength," a quality affected by sand layers, worms burrows, shells and other factors.

Roots of scholarliness

What makes a good student? In a survey of 20 public high schools conducted by faculty members of *Johns Hopkins University, Dartmouth College* and *Vanderbilt University,* scholastic achievement was up in schools where academic competition, intellectualism and student competence in subject matter were emphasized. Achievement showed no observable relationship to social class of the students' parents, the size of teachers' salaries, or per-pupil expenditures, according to the results of this study.

Cholesterol and health

The Masai tribesmen of Kenya in Africa stay thin and have almost no heart disease although they eat at least as much cholesterol as most Americans, two *Northwestern University* scientists report. The reason for the difference, they suggest, is genetic.

What happens when the average American eats cholesterol is that several organs of the body, primarily the liver, change cholesterol into smaller molecules of beta lipoproteins that are deposited in the veins and arteries. The more cholesterol they eat, the more beta lipoproteins are synthesized. Eventually, the fat deposited in the blood vessels leads to arteriosclerosis and heart disease.

The Masai seem to have what Dr. C. Bruce Taylor calls a "remarkable mechanism for making only so much beta lipoproteins and no more, no matter how much cholesterol they eat." Although Dr. Taylor and his colleague, Dr. Kang-jey Ho, can't find the reason for the mechanism, they think it must be a genetic trait.

Fossil jellyfish

On a *Rutgers University* field trip last spring, an 18-year-old geology student found an unknown fossil jellyfish in the mudstone along the Delaware River. Since then 45 more specimens have been found on the river banks. About two inches long and an inch wide, the fossils are estimated to be 425 million years old. The only creatures that resemble them are some older fossils found in South Australia, but more research will be needed before any link can be established between American and Australian specimens.

Bottom charting "Little Giant," aluminum cathedral hull, carries outrigger "fish" . . .

HYDRA = for bottom lowdown

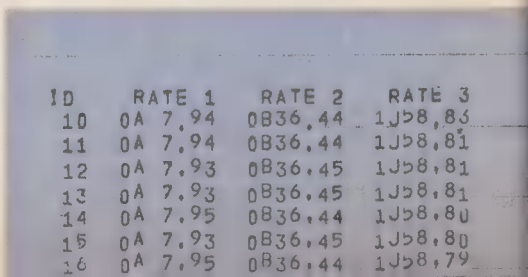
Fleets of speedboats soon may sweep our harbors, charting the shifting sea bottom electronically.

by Richard Dempewolff

LAST SUMMER, four curiously rigged high-speed boats hammered over the heavy chop of Chesapeake Bay, and zig-zagged up and down the winding Potomac River. Sometimes they went in "V" formation; sometimes abreast. They operated singly; in pairs and sometimes all together. They combed the water—from a snail's pace, leaving hardly a ripple, to a roaring 25-30 knots, throwing rooster tails skyward behind them in sweeping patterns.

What they are "trying out" for is hardly a marine ballet troupe. If the humming electronic gear, whirring magnetic tape and flashing digital read-outs aboard the lead boat perform as expected, the tedious bottom-charting of coastal waters and river channels will be a thing of the past.

Carried into bays or estuaries on the back of a big hydrographic sur-



On board digital read-out gives second-by-second code, depth value, position coordinates and instant of time. From all of this data, a contour chart of the sea bottom covered in a single sweep of a harbor or inlet can be plotted instantly.

Thunderbird 170 has transducers built into deep V hull. Both have 120 hp stern drive.

vey "mother ship," these 16-to-20-foot craft will be dropped off in squadrons of five. On a single high-speed run in pre-determined patterns, they'll make an "acoustic rake" of the entire bottom. Job done, they'll rendezvous with the mother ship, be hauled aboard and proceed to the next area to be charted down the coast.

The idea for this unique and speedy method of bottom charting in shallow waters sprang from agile minds in the Charting Techniques Branch of the U.S. Naval Oceanographic Office's Hydrographic Development Division R & D "think tank."

Early last summer, a team of five men under HYDRA (Hydrographic Positioning and Recording System), chose four 16-to-18-foot commercial boats—a Boston Whaler fiberglass cathedral hull powered by a 100 hp outboard; a Thunderbird 170 fiberglass deep V hull with 120 hp stern drive; a Maritime "Little Giant" aluminum cathedral hull driven by 120 hp stern drive; a Maritime "Prince Edward" aluminum deep V hull with 100 hp outboard. Object of the variety in design and power: to see which combination of features would provide the best, sturdiest stable platform in the widest variety of weather and sea.

Today, fitted out with wild enclosures (the "Little Giant's" superstructure looks like an airstrip

DATE 5 8 68 PAGE 24

LUE	NORTHING	EASTING	LATITUDE	LONGITUDE	TIME
9.5	3365535.1	544591.2	30 25 21.72	86 32 8.51	12 53 10
9.5	3365535.1	544591.2	30 25 21.72	86 32 8.51	12 53 11
9.5	3365544.2	544581.8	30 25 22.01	86 32 8.86	12 53 12
9.5	3365544.2	544581.8	30 25 22.01	86 32 8.86	12 53 13
9.5	3365525.8	544594.4	30 25 21.41	86 32 8.39	12 53 14
9.5	3365544.2	544581.8	30 25 22.01	86 32 8.86	12 53 15
9.5	3365525.8	544594.4	30 25 21.41	86 32 8.39	12 53 16

control tower on a raft), hull-bottom and over-the-side "fish" transducers, and a phenomenally compact digital read-out system, the tiny fleet operates as Project XSSL (Experimental Small Survey Launch).

Last August, squeezed against the starboard side of the Giant as she thumped and heaved across the Chesapeake, I watched the digital display of instantaneous bottom soundings, time signals and co-ordinates under the watchful eyes of Dan Dixon, team Cartographer. John Spinning, physical scientist and Party Chief, described the whirring, blinking confusion on the depth sounder and positioner, while Mechanical Engineering Technician Frank Dendis steered us a thumping, zig-zag course across the brisk chop.

The system, he explained, depends in part on three compact, portable transmitters, spotted on mainland beaches or islands, forming a vast triangle for position-finding. Signals from the transmitters are picked up by receiver and fed continuously to the digital unit, along with local time signals and sonic depth data from the transducers. All these inputs zip through a maze of circuitry, where they are digested, combined and spewed out as sensible records on tape. A visual print-out (see page 77) spells out — second-by-second — the time (to the second), depth at that instant, and the pin-pointed position of the transducer.

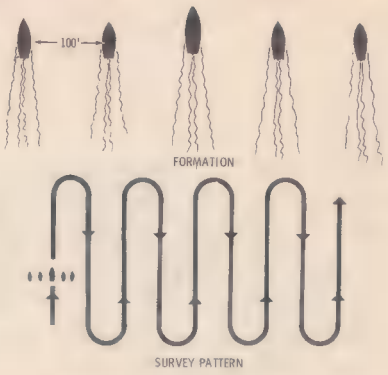
"Beauty of the system," says Spinning, "is that minutes after a harbor sweep, the tapes can be delivered to the mother ship and turned, immediately, into a bottom chart of the entire harbor."

Last year, Project XSSL's team spent most of its time readying

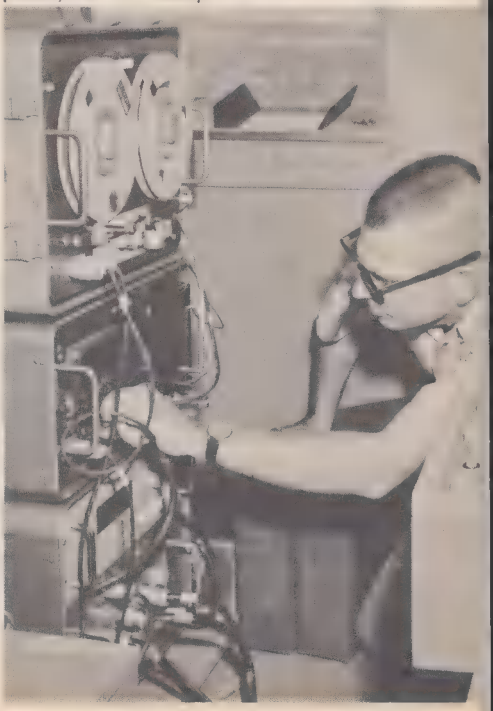
Transmitter goes up on pre-determined shore point. Three of these portable units form a vast network of radio signals to boats making acoustic rake. Signals give each boat its precise position on the sea at any given second during a harbor area sweep.

boats and gear for evaluation. The HYDRA system—originally half the size of the boat—is now a three-tiered stack scarcely bigger than an orange crate. The R & D Lab is cluttered with varied configurations of streamlined outriggers and "fish" (properly decorated with sharks' teeth). The one that holds the transducers on a steady course below the surface at all speeds must be determined in tests.

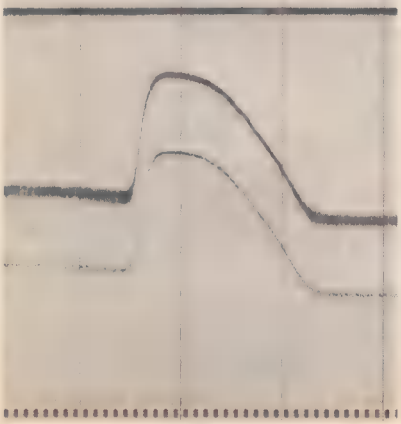
Which of the four hulls will prove itself most stable, sturdy and seaworthy is something everyone would like to know—including the manufacturers. This summer's tests will tell the tale. If the system proves feasible, you may soon see small craft zig-zagging over our coastal waters on continuous bottom surveys. That will be HYDRA at work.



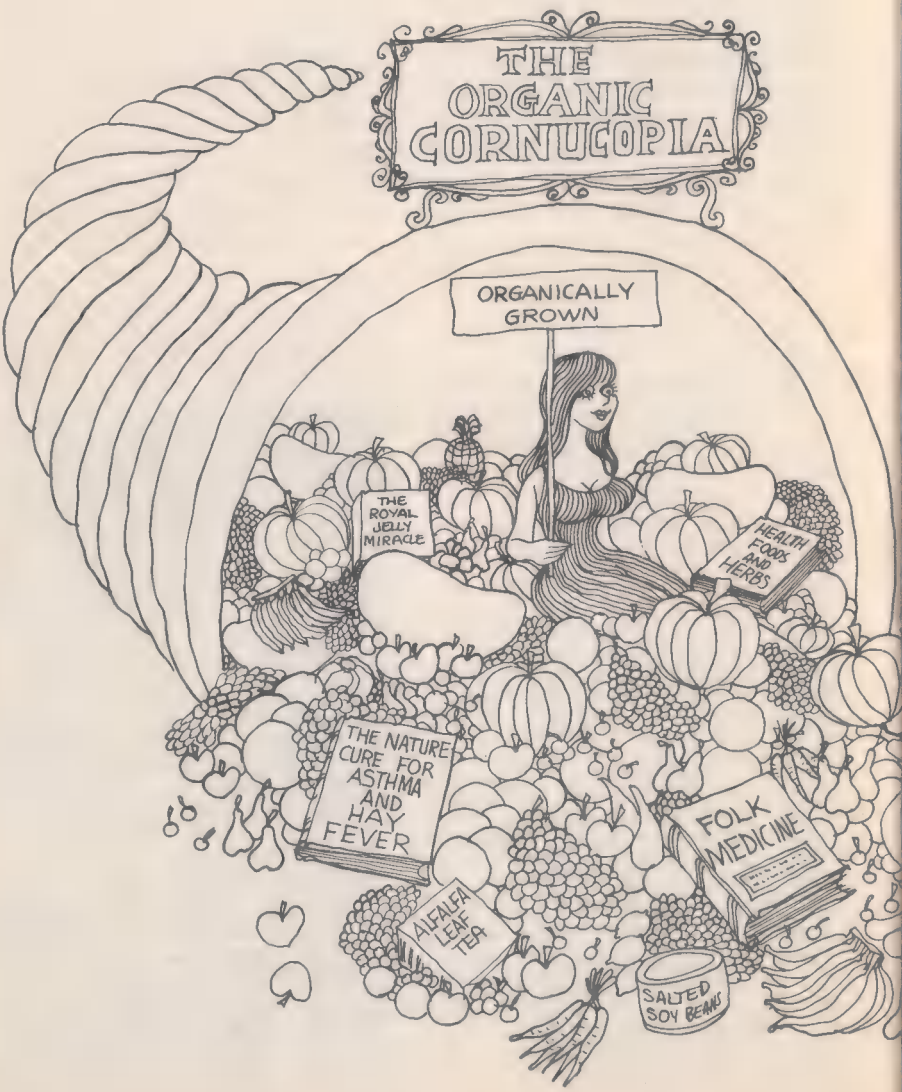
Sweep pattern of acoustic rake may differ on open water and rivers, but boats move together—abreast or, in tight places, in "V" sweep.



Bottom contour of each boat's own track is scribed on a graphic recorder. Data also is fed to the magnetic tape.



The wacky


THE ORGANIC CORNUCOPIA
ORGANICALLY GROWN
THE ROYAL JELLY MIRACLE
HEALTH FOODS AND HERBS
THE NATURE CURE FOR ASTHMA AND HAY FEVER
FOLK MEDICINE
ALFALFA LEAF TEA
SALTED SOY BEANS

world of food fads

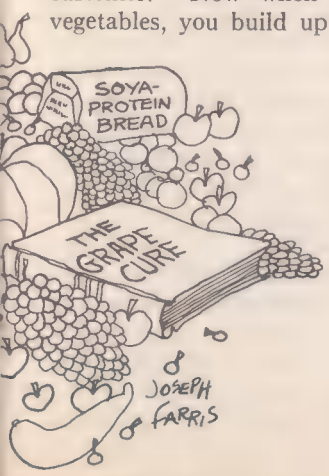
by Barbara O'Connell

IN a health food store in midtown Manhattan, a well-built middle-aged man in a sport shirt pokes raw celery, carrots and leafy vegetables into the top of a small machine. "This is the natural juice you're getting, not that stuff from cans that is *destroying* the human body," he tells his audience, two small boys. When the machine stops, he pours a thick green fluid into two paper cups and gives the boys each one.

"It's a lot different from that *poison* you usually drink, isn't it, fellows?"

"Yeah," says one, doubtfully. His friend giggles. But they finish the juice; it's free.

"The machine is sixty-nine ninety-five on sale," he tells another customer. "Now when you cook vegetables, you build up *poisonous masses*, but when you use this. . . ."



The same scene, or one like it, plays every day in health food stores across the land, whether the clerk is pushing a sixty-nine ninety-five blender or a 79-cent bag of soy bean flour. Health food labels are controlled by Federal law but health food clerks aren't. Free to proffer any nutritional advice they want, they refer darkly to canned or frozen foods ("poisonous," "destroy"), sing the praises of their own products ("natural," "real"). Certain pitches are standard. Enriched white flours are "dead," "robbed of vital nutrients by processing." Much of the food grown on American farms is "worthless" since it comes from "exhausted" soils treated with "poisonous" fertilizers and insecticides. The preservatives used in processing foods are also suspect, according to these faddists. The solution, of course, is to buy health foods.

Actually, there's nothing much wrong with health foods, except that they're overpriced, underseasoned—and, according to reputable nutritionists, unnecessary. Such products have no special properties that can't be found in other foods readily available in American markets. As for the vitamin and mineral preparations that health food stores and many other outlets offer, they can't hurt you if you don't take too many. Unfortunately, say the experts, they

can't help the person who eats a balanced diet except in special cases. "Extra" vitamins and minerals, ones that our body doesn't need, are simply eliminated in short order.

But many Americans seem to be listening to the health food spielers rather than the nutritionists. In any one year, says *Consumers Union*, we buy half a billion dollars worth of health foods and nutrition supplements. Not all the purchasers are hard core food faddists, who are estimated to number in the hundreds of thousands. Most of us, at one time or another, purchase a health food, a bottle of vitamin or mineral tablets, or a protein supplement. And some regularly-used American foods really started out as health foods: graham crackers, peanut butter, prepared breakfast cereals, yogurt, Postum.

Trying a few

Since I'd never tasted any health food store products, I bought a number of items from four Manhattan health food outlets and toted them back to the office to try them for myself. Among my purchases were: soya-protein bread, 51 cents a loaf; "Vigerola," a chewy product made from oatmeal, 49 cents for an eight-ounce package; a small package of salted soy beans, 20 cents; a Tiger's Milk candy bar, 25 cents; "organic" honey, 79 cents for a one-pound jar; half-a-dozen oatmeal cookies with, the label assured me, "No Harmful Additives," 59 cents, and a small box of alfalfa leaf tea bags, "organically grown," for 40 cents. I noted some other products: whole wheat bread, 10 heavy slices of which weigh one and one half pounds; a bag of imported "whole maize flakes" that looked like shredded foam rubber and "Irish Moss Powder" from Ireland. Three of the stores I visited offered no meat, but the largest sold ground beef from "organically-raised" cattle at $1.79 a pound. The organically-grown fruit I saw at this store looked much punier than that in the average supermarket, but the vegetables compared favorably in looks if not in price. Tomatoes, for example, were 79 cents a pound.

"Organically grown" or "organically raised" is a term you'll encounter often in health food stores. "Organically grown" means that the product was grown without the use of chemical fertilizers or insecticides. "Organically raised" meat or eggs are produced from animals fed on organically-grown products (a practical impossibility, says one expert). Does organic farming have any value? Dr. George Briggs, Chairman of the Division of Nutritional Sciences at the University of California at Berkeley says: "There's no evidence of major nutrient difference between organic foods and others."

The first thing I found about health foods when I unpacked my shopping bag was that the labels revealed far more than I wanted to know about the contents. The label on my tiny package of soy beans covered nine square inches and car-

Health foods lack excitement for the non-food faddist who is a lot calmer about what he eats.

ried a listing of proteins, "essential amino acids" by percentages (there were 10 of them), and a rundown by grams of thiamine, riboflavin, niacin, ascorbic acid, iron, phosphorous, calcium, potassium and sodium.

The second thing I discovered was that health foods lack excitement for the non-food faddist, who is a lot calmer about food than his faddish brethren. "Well, they're all right," said an editor, munching a cookie manufactured "according to exacting specifications" and containing such goodies as sea salt, super-hi protein, raw sugar and soy flour. One secretary refused a helping of "Vigerola" ("Don't give me that!") and a braver one said "huh" after chewing a mouthful. The Soya-flour bread, dry and dark, produced little enthusiasm even when spread with organic honey—in spite of the fact that it contains "as much protein as about three dozen eggs, six quarts of milk or two pounds of boneless meat." The only products that went over were the salted soy beans, which taste much like any salted nuts, and the honey, which tastes much like any honey. As an inveterate tea drinker, I was the only one who tried the alfalfa tea, and I liked it better than any of the other products. In fact, I'm going to buy a big box of it next time I see it.

I also brought back a pile of literature from the health food stores, ranging from catalogues to paperback books. I saw a few hardbound books I wanted to buy but hestitated to put them on an expense account, such as *How to Live in a State of Orgasm* and *Faith, Love and Seaweed. The Grape Cure,* a purple-bound volume, asks the interesting question, "What mysterious ingredient unknown to science is found in this queen of fruits?" But the literature I did buy was astounding enough. The things I didn't know! In *The Nature Cure for Asthma and Hay Fever,* for example, I found that the effect of an early-morning cup of tea—not alfalfa tea, but good old ordinary Lipton's—is to "thrust poisons drawn from the tissues during sleep back into the body." An attractive little paperback called *Health Foods and Herbs* admonished me that, "The whiter the bread, the sooner you're dead." In *The Royal Jelly Miracle* I read that a Dr. O'Connel (no first name or other identification given, which is usual in these publications) reports "results" (good? bad?) from feeding royal jelly to patients with Parkinson's and Buerger's diseases. *Prevention,* the largest circulating magazine in the food fad field (450,000), suggested that fluoridation affects sex hormones.

These are only a few examples of what Dr. William Pearson, a biochemist at Vanderbilt University in Tennessee, calls "the maliterature of

nutrition." "Nutrition is like an iceberg," he says. "The real developments are on the top, the pretty good stuff in the center and the base is 'don't knows' and 'bad.' Popular nutrition books pick up most of their material from the bottom layer because it's more exciting." The scary thing about this literature is that it's read by millions of Americans, some of them undoubtedly ill. If an arthritis or cancer victim decides to postpone medical treatment while he tries a "natural" cure espoused in a popular health book, the delay could have serious consequences. Even the relatively healthy reader who tries some of the wacky diets advocated in popular literature can undermine his health.

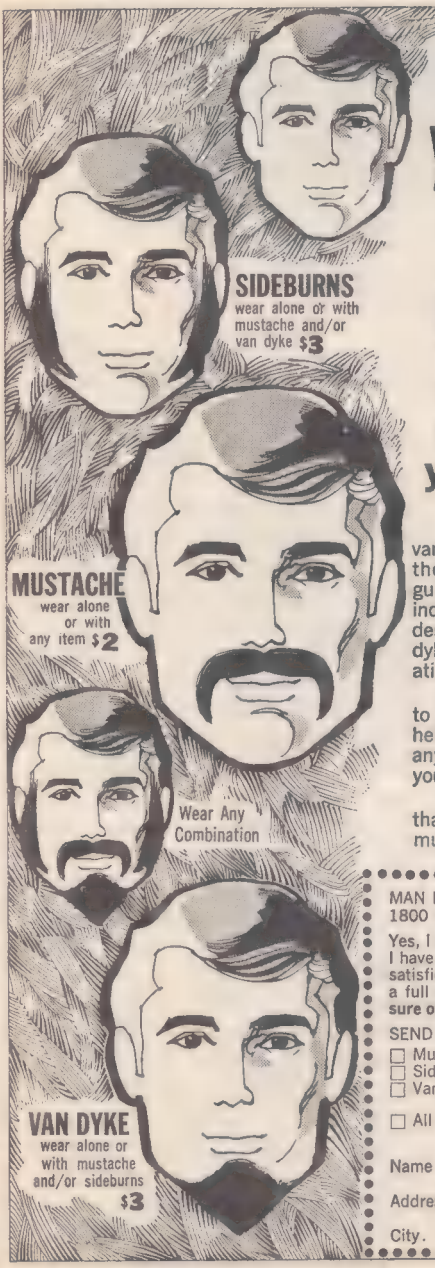
Fortunately, most of the diets described in health books are so weird that people won't follow them for long. But there are always exceptions. In New York, a young woman recently starved herself to death on the Zen Macrobiotic diet, which is popular among hippies. A hardback book called *Zen Macrobiotic Diet* sells well on health food book racks, and a health food supermarket in Manhattan offers weekly cooking classes in Zen Macrobiotic foods. Briefly, MB, as its adherents call it, involves seven levels of progressively more severe diets, the last of which consists solely of brown rice. Every mouthful of food must be chewed at least 50 times as fluid intake is strictly limited. Such a dietary regime will produce spiritual enlightenment, as well as ward off old age and illness, says its founder, Japanese author Georges Ohsawa. MB dieters seem to agree with him. "I've never felt better," observed one Harvard student. "My asthma has cleared up, my headaches are gone, my back has stopped aching, and I need two hours less sleep a night." Another Harvard MB man reported that "your mind escapes from your body."

Dr. Stare sees MB differently. "Macrobiotic effects," he says, "have nothing to do with the magical properties of brown rice. They are simply symptoms of mild starvation accentuated by psychological suggestion."

Good nutrition, the experts say, is much less complicated than food faddists would have us believe. There is no wonder food we must discover; there are no mysterious substances unknown to science but vital to the diet; processed foods are not "poisoning" us, nor are chemical fertilizers "robbing" our food. To eat well, it isn't necessary to juggle food components with the precision of a chemist in a laboratory. What is necessary is to eat a balanced diet of dairy foods, fruits, vegetables, meat, eggs and grain. Children, teen-agers and prospective and nursing mothers usually need additional Vitamin D.

Says Dr. Stare: "Everything that is required is in everyday stores in splendid and varied profusion: minerals and vitamins, proteins and carbohydrates, food with low fats and foods with high fats, foods for all ages and needs."

It's as simple as that.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Wear Any Combination
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Each month Dr. Isaac Asimov chooses one of the questions you send in to answer. He does not make the job easy on himself, for in past months he has written about such things as relativity, parity and the basic nature of light. Following Dr. Asimov's answer are the answers to some of your other questions written by regular members of the *Science Digest* staff.

The truth in Gödel's proof

What is Gödel's proof? Does it show truth is unobtainable?

Ever since the time of Euclid, 2,200 years ago, mathematicians have tried to begin with certain statements called "axioms" and then deduce from them all sorts of useful conclusions.

In some ways it is almost like a game, with two rules. First, the axioms must be as few as possible. If you can deduce one axiom from the others, that deduced axiom must be dropped. Second, the axioms must be self-consistent. It must never be possible to deduce two conclusions from the axioms with one the negative of the other.

Any high school geometry book begins with a set of axioms: that through any two points only one straight line can be drawn; that the whole is equal to the sum of the parts and so on. For a long time, it was assumed that Euclid's axioms were the only ones that could build up a self-consistent geometry so that they were "true."

In the 19th century, however, it was shown that Euclid's axioms could be changed in certain ways and that different, "non-Euclidean geometries" could be built up as a result. Each geometry was different from the others, but each was self-consistent. After that it made no sense to ask which was "true." One asked instead which was useful.

In fact, there are many sets of axioms out of which a self-consistent system of mathematics could be built; each one different, each one self-consistent.

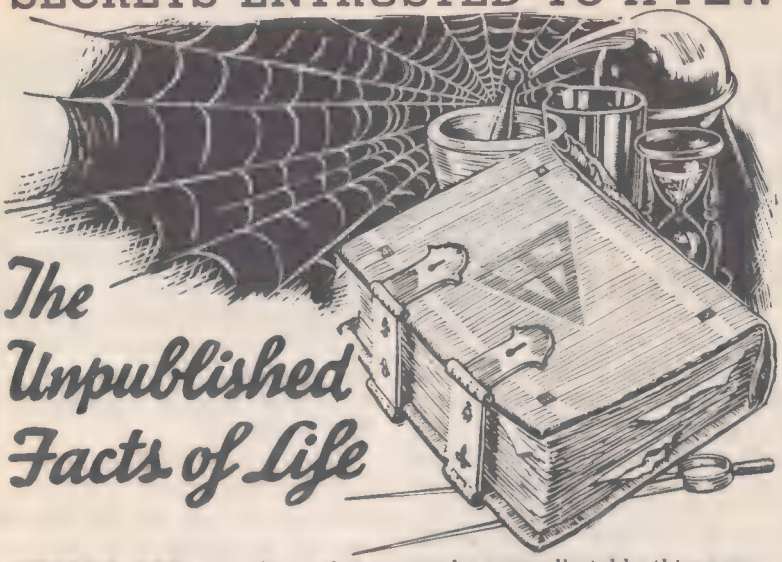
In any such system of mathematics you must not be able to deduce from its axioms that something is *both* so *and* not-so, for then the mathematics would not be self-consistent and would have to be scrapped. But what if you make a statement that you can't prove to be *either* so *or* not-so?

Suppose, that I say, "The statement I am now making is false!"

Is it false? If it is false, then it is false that I am saying something

(Text continued on page 88.)

SECRETS ENTRUSTED TO A FEW



The Unpublished Facts of Life

THERE ARE some things that can not be generally told—*things you ought to know*. Great truths are dangerous to some—but factors for *personal power* and *accomplishment* in the hands of those who understand them. Behind the tales of the miracles and mysteries of the ancients, lie centuries of their secret probing into nature's laws—their amazing discoveries of *the hidden processes of man's mind,* and *the mastery of life's problems.* Once shrouded in mystery to avoid their destruction by mass fear and ignorance, these facts remain a useful heritage for the thousands of men and women who privately use them in their homes today.

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false and I must be saying something true. But if I am saying something true then it is true that I am saying something false, and I am indeed saying something false. I can go back and forth forever. It is impossible to show that what I have said is *either* so *or* not-so.

Suppose you adjust the axioms of logic to eliminate the possibility of my making statements like that. Can you find some other way of making such neither-so-nor-not-so statements?

In 1931, an Austrian mathematician, Kurt Gödel, presented a valid proof that showed that for any set of axioms you can make statements that cannot be shown to be so from those axioms and yet cannot be shown to be not-so either. In that sense, it is impossible to work out, ever, a set of axioms from which you can deduce a *complete* mathematical system.

Does that mean that we can never find "truth?" Not at all!

First: Just because a mathematical system isn't complete doesn't mean that what it does contain is "false." Such a system can still be extremely useful provided we do not try to use it beyond its limits.

Second: Gödel's proof applies only to deductive systems of the types used in mathematics. But deduction is not the only way to discover "truth." No axioms can allow us to deduce the dimensions of the solar system. Those dimensions were obtained by observations and measurements—another route to "truth."—*Isaac Asimov*

Your vision—

what do you know about it?

by John and Molly Daugherty

ONE LINE OF RESEARCH on the eye points the way to earlier diagnosis of eye ailments. The fluorescent dye, fluorescein, injected into the bloodstream permits the observation of the blood flow in the vessels of the eye. Photographs and even motion pictures can be taken of the flow in choroid coat, retina and other parts.

What do you know about your vision?

1. The contact lens which is used to treat some corneal diseases and injuries to the eye, rather than to correct vision is a
   a. Regular scleral lens
   b. Flush-fitting scleral lens
   c. Corneal lens
2. In the evolution of the eye, the most finely developed sight belongs to
   a. The bird
   b. Man
   c. *Euglena viridis*
3. Birds (with eyes on the sides of the head) can see both backward and forward. They have no blind zone. Man's field of peripheral vision is slightly more than 180°. Tests at Yale University show that a single alcoholic drink causes
   a. An increase in peripheral vision
   b. No noticeable change in peripheral vision
   c. A decrease in peripheral vision
4. The principle or theory of contact lenses was described by
   a. Benjamin Franklin
   b. Thomas Edison
   c. Sir John Herschel
5. Apparently inactivity of the eye can cause deterioration in some of its functions. The U.S. Navy noted that men submerged for long periods of time in atomic submarines developed a form of
   a. Irregularity in the shape of the cornea or lens or both (astigmatism)
   b. Nearsightedness (myopia)
   c. Farsightedness (hyperopia)
6. You may see better than someone else with equal vision. You also may see some things better than other things even though they are of equal size and at equal distance from you because
   a. What you see is matched against information stored in your brain to render visual perception

b. There is no retention of an image on the retina
c. Of presbyopia, which develops with aging and results in a lack of flexibility in the eye lens

7. The part of the brain which interprets what we see sometimes errs, giving us optical illusions. Colors may give optical illusions, too, and artists use this in their paintings. The color in a painting which would seem to be closest to you is
a. Blue
b. Red
c. Yellow

8. Surgical operations for cataract of the eye apparently were first performed by
a. The Persians
b. The Greeks
c. The Egyptians

9. The iris of the eye controls the size of the pupil. It's located between the cornea of the eye and the lens. The size of the opening varies with the distance being viewed. It's larger for distant objects. The size of the pupil varies also with your emotions. It becomes smaller if you are
a. In pain
b. Afraid
c. Angry

10. Early diagnosis to prevent blindness is usually of least value in
a. Cataracts
b. Glaucoma
c. General diseases like diabetes and hypertension

Answers:

1—b Flush-fitting scleral lens. At Baylor University this type of lens has been used to treat more than 100 patients for certain diseases of the cornea as well as injuries to the eye, such as ulcerations, burns from alkali and infections.

The scleral lens is the oldest type of contact lens. It's molded to the sclera, the white protective coat of the eye.

The corneal lens is most widely used, and is molded only to the cornea. About nine million people in the U.S. wear this type.

2—a The bird. Birds can see a grain of seed from a distance of about 100 yards, but man can only see the seed when he is about five feet or less from it.

The *Euglena*, an aquatic form of primitive life, can distinguish only differences in light intensities: darkness, brightness and twilight. It prefers twilight. Its eye is only a single protuberance, the most primitive type.

3—c A decrease in peripheral vision. The decrease in the field of vision may be enough to prevent a driver from seeing another car coming from the side—too late to avoid an accident.

Other causes of decreased peripheral vision may be aging, chemical substances such as drugs, and even tobacco smoke.

4—c Sir John Herschel. In 1827 Herschel described the principle of the contact lens. The first usable contact lenses (glass) were not made until 1911.

The corneal contact lens appeared in 1948, and by 1955, were in general use.

Benjamin Franklin was the originator of the bifocal lenses for eyeglasses.

5—b Nearsightedness (myopia). Apparently this developed from the lack of exercise in distance vision, which involves muscular changes in flexing the eye lens and other changes included in distance-viewing. Retraining and restimulation to exercise the eye should restore the eye to normal.

6—a What you see is matched against information stored in your brain to render visual *perception.*

Perhaps this accounts for some astronauts reporting seeing things on earth which normally at such great distances cannot be seen. Some faint clues led to their perception.

You may see a friend at a great distance though you do not recognize an acquaintance with him. You need only the barest details to go with information in your brain about your friend to complete the visual *perception.*

7—b Red. Red has a longer wavelength than the other colors in the visual spectrum. Red is bent more in refraction by the eye lens than any of the other colors which have shorter wavelengths. The lens takes the shape of a slightly closer object. The interpretation by the brain makes the red stand out from the flat painting.

8—c The Egyptians. The operation called *couching* consisted of pushing the clouded lens to one side. This permitted light to reach the retina in the back of the eye. The operation was performed for thousands of years dating from about 3500 B.C. or earlier.

Egyptian eye specialists traveled to foreign lands to treat patients. According to a tablet in the British Museum, Cryus, King of Persia, had an Egyptian specialist treat his mother's eyes.

9—c Angry. When your emotion is one of anger the pupil becomes smaller. When you fear, the pupil becomes larger. When you are in pain it becomes larger.

Some narcotics reduce the pupil to pinpoints.

10—a Cataracts. Even if cataracts are detected early they aren't preventable but can be corrected to a considerable degree through surgery. The surgery involves removal of the eye lens, and substitution of a contact lens or other type of corrective lens.

Much of the damage of glaucoma is preventable with early detection. Lack of this detection causes it to remain a major cause of blindness.

General diseases can be controlled to prevent blindness. About 16 percent of all blindness comes from general diseases rather than from diseases of the eye.

Score yourself:

9—10 right—You saw right through this!

4— 8 right—Let this be an eye-opener.

0— 3 right—your score's an eye-sore.

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Island of Adventure. Ross E. Hutchins. Dodd, Mead & Co. ($6.00) Mississippi's Pascaguoula River, just before it empties into the Gulf of Mexico, is a marshland much like the Everglades. A vast array of animal and plant life inhabit this island, and it truly is an adventure to explore it with the author.

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99 Ways to Use Your Oscilloscope. A.C.W. Saunders. Tab Books. ($6.95). Here's a test equipment guide book which gives step-by-step instructions on using the oscilloscope in just about any situation that would be encountered.

RCA Solid-State Hobby Circuits Manual. Radio Corporation of America. ($1.75 paperback). Electronics hobbyists will find detailed accounts of solid-state circuits which can be built as well as many pictures and diagrams that deal with the subject.

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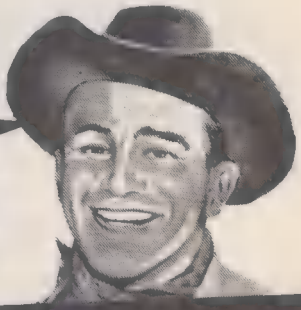

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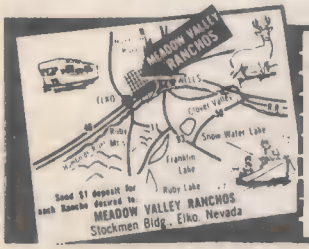

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WHEN Answering classified advertisements, don't forget to say you saw it in Science Digest.

Apologies to the Pope

I question one of the articles in the December '68 *Science Digest*, page 7. In "St. Peter's Bones—are they or aren't they?", you say in the second paragraph, "Early last summer Pope Paul XXIII . . . ." Isn't this an error? The present Pope is Pope Paul VI and not the XXIII. If you refer to Pope John, he was not alive last summer.

KATHY CROTTY
Fort Pierce, Fla.

You are correct—Pope Paul's title is "VI," not "XXIII" as mentioned in the article. It was his predecessor, Pope John, who was the XXIII. Pope Paul VI announced that St. Peter's bones had been found beneath the Vatican. In writing the article, Pope John's title was confused with Pope Paul's.—Ed.

Chimps for manual labor?

It seems to me that chimpanzees might be trained to do useful work (such as harvesting fruit) and be motivated by a reward of food. Is any research being done in this area?

FRED GERMANN

A decade ago there was unsuccessful research in this area, but see page 73 for the story of research being done to teach chimps to communicate with people through sign language. —Ed.

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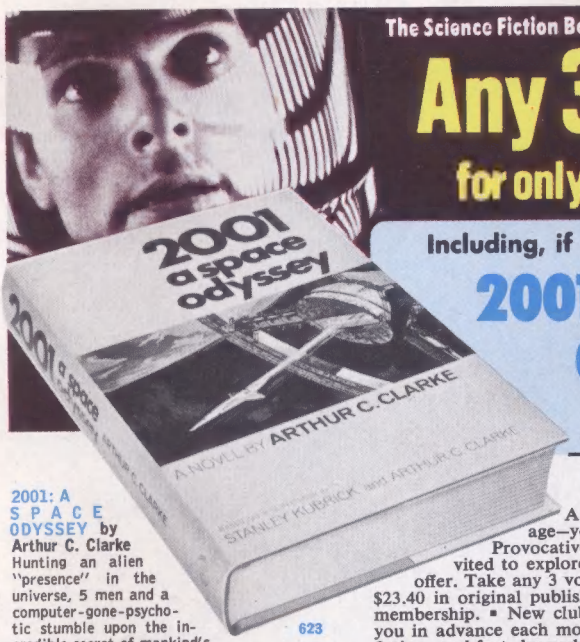
Photo by A. J. Mueller

Winter's tribute

ONE of the big snows in Waushara County, Wisconsin, accidently produced a piece of sculpture that looks very much like a profile familiar to all Americans. Piling up on an abandoned bird's nest, the snow was shaped by the wind moving the branches of a tree. The December snow storm's sculpture was a little early for George Washington's birthday, February 22nd, but appropriate all the same.



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